ANNUAL REVIEW SECTION

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A Year of Retrogression in the Iron Trade

Depression of 1913 Greatly Intensified in 1914—One of the Worst Years Ever Known—Continued Shocks to Confidence

GENERAL REVIEW OF THE YEAR'S BUSINESS

Measured by financial results, the year just ended has been one of the most distressing ever experienced by the iron trade. With few exceptions, every manufacturer of iron and steel has been obliged to draw on the surplus accumulated in happier days to meet current expenses. Early in the year the manufacturers of pig iron became so concerned over the condition of their trade that the American Pig Iron Association instituted an inquiry into the relation of cost of production to the prices at which its members were being forced to sell, and ascertained that the average loss in February was 95c. per ton and that the total loss on their unfilled orders would be $1,251,804.73. The United States Steel Corporation barely earned its preferred stock dividend in the quarter ended March 31, and after paying its common stock dividend had a deficit of $6,289,644. Financial conditions steadily grew worse as the year advanced and losses became so heavy that one steel company after another was obliged to forego the payment of dividends. It was a year in which no iron or steel manufacturer was able to make any additions to funds for improvements or the replacement of plant, which, in this branch of business, more than any other, is so imperatively necessary if a manufacturer would maintain his footing.

GREAT DECLINE IN PRODUCTION

The production of iron and steel shrank heavily. It is estimated that the falling off, as compared with 1913, the year of largest output, was not less than 25 per cent. With the sole exception of 1908, it is expected that when the figures of production shall have been compiled they will show that 1914 was the smallest year in iron and steel production since 1905.

In the first quarter of the year there was some recovery from the stagnation of business which had marked the closing weeks of 1913, a number of idle blast furnaces resumed operations and the production of the steel mills ran up to over 80 per cent. of their capacity. But the improvement in demand was of short duration, being merely a replenishment of stocks. It was like a cloudburst which fills a watercourse, but as there is no repetition the stream steadily shrinks. Thus, with orders diminishing in number and size, the rate of production correspondingly fell until, in the late summer and fall months, the steel output was barely 35 per cent. of the capacity of the works. In fact, for a brief period some of the largest steel manufacturers of the country were only able to run at about 25 per cent. A striking example of the appalling shrinkage in the iron trade of 1914 is afforded by the statistics of water shipments of Lake Superior ore. The total for the season of 1914 was but 32,021,900 gross tons, as compared with 49,070,478 tons in 1913, being a decline of 17,048,578 tons, or over 37 per cent.

CAUSES OF THE DEPRESSION

The most important cause of the depression in the iron trade was political, this having projected itself in two ways, namely, the harassing of large business interests by drastic Congressional legislation and the opening up of our markets to sharp foreign competition by the new Underwood tariff which had become effective in October, 1913. Next in importance was the steadily diminished volume of buying by the railroads, whose traffic dwindled as the business of the country fell off, thus lessening their earnings until the most stringent economy was necessary to enable them to meet running expenses and fixed charges. The Mexican situation was also a disturbing influence, as it was feared that our occupation of Vera Cruz might lead to actual war with our Southern neighbor.

To cap the climax came the European war, with its dislocation of commerce and finance throughout the world, catching us at a time when the new tariff had involved us heavily in debt to foreign countries, precipitating on us a sudden demand for gold to meet not only that indebtedness but to take

up a considerable bulk of our securities thrown on our markets by foreign holders and bringing about such a stringency of credit and currency as almost to paralyze business. It is true that the domestic situation was relieved to some extent by the issue of a large volume of emergency currency by the Treasury Department, but for a considerable time banking accommodations were severely restricted and exorbitant rates of interest were charged.

The South, which had been enjoying exceptional prosperity for several years, was struck a stunning blow in the complete stoppage of its exports of cotton by reason of the scarcity of vessels when the belligerent nations began to prey on the commerce of one another. For the same reason, the supply of important raw materials was cut off and numerous manufacturers were brought to an acute realization of their dependence in some degree on foreign producers. Under such circumstances as these extreme conservatism was the general policy and other branches of business suffered as well as the iron trade.

FAVORABLE DEVELOPMENTS OVERSHADOWED

Some of the developments of the year would have been of a stimulating character if they had not been so completely overshadowed by the adverse influences above referred to. The wheat crop was the largest ever harvested, while other crops were abundant. Instead of this outcome of farmers' activities bringing prosperity to implement manufacturers, which should have been the natural result, their trade suffered from the general policy of conservative buying, and they consumed less iron and steel than in a year of moderate farm yields.

The opening of the Panama Canal had been expected to usher in a new era of commercial development and was the immediate cause of much activity in shipyards in preparation for it. But when it was formally opened, on August 15, the European war was in active progress and the great achievement of connecting the Atlantic and Pacific by a navigable waterway hardly attracted more attention than the opening of the Cape Cod Canal because of the prostration of international commerce.

The breaking out of the European war was at first expected to be of vast benefit to the business interests of the United States. The belligerent nations would need food and other supplies which we are so abundantly able to furnish them, while their complete or even partial retirement from the markets of the world, it was confidently supposed, would give us an opportunity to increase heavily our export trade in manufactured products. In the course of time, but not immediately, we began to receive the expected business in foodstuffs and army supplies and considerable unexpected business in machine tools from the belligerents, but we have yet to see the great influx of orders for manufactured products from neutral markets. So many of the leading countries of the world are involved in the war that the finances of neutral countries are entangled to such an extent that their buying power is seriously affected.

EFFECT OF THE UNDERWOOD TARIFF

The Underwood tariff would probably have made a greater impression on our iron trade if the business of the past year had not been conducted so conservatively by all classes of buyers. Inroads were made by foreign manufacturers along the Atlantic and Gulf coasts, and they almost captured the trade of the Pacific coast.

Wire nails of foreign origin obtained a foothold in New England; Nova Scotian and English pig iron made a good start in the foundries of eastern Pennsylvania; German and Belgian billets and steel bars were sold in round lots in New England, and English and German cotton-ties baled a considerable part of the cotton crop.

Our manufacturers were becoming uneasy as evidences of the activity of foreign selling agencies became stronger and indications grew more apparent that an improvement in general business would bring about greatly increased importations. But the European war suddenly checked sales here of foreign iron and steel and those who had placed orders abroad could not get deliveries. Thus the foreign invasion has temporarily ceased, and it is hoped that steps may be taken in the not distant future to prevent its recurrence by a sober and chastened Congress.

Details of the course of prices throughout the year and of developments in the various branches of the trade in leading commercial centers will be found in the reports and price tables which follow.

The Chicago Iron Trade in 1914

BY O. J. ABELL

The narrative of 1914 in the iron and steel business is a drab-colored record of hopes deferred. Very little can be said of passing events in this or any particular district which is not equally applicable to conditions that have prevailed throughout the country. Lack of business has been the common lot. So the year began and so it has ended. The default of railroad buying was especially discouraging.

Reviewing the trend of the market through the several periods of the year one observes, somewhat curiously perhaps, with what groping about for causes and explanations and with what manner of prospects the trade has sought to sustain its intermittent hope of better things to come. Aside from the generally unexpected shock of war, it is a little startling to discover to how limited an extent the average business man seems to have understood the effective influences that dominated his affairs. Like the faltering swimmer, who somewhat panicky grasps at every piece of passing driftwood only to find that it will carry no weight, the trade has gone from week to week building expectations upon circumstances which, maturing, passed without apparent benefit and in retrospect seemed almost irrelevant. Meanwhile depressing influences continued unceasingly operative. Unusually prolific of such experience have been the conditions of doing business in iron and steel during the year just closed.

During the first three months of the year developments gave some promise of bearing out the prophesy of prosperity in 1914. Stocks were at a very low point

everywhere. Users of steel were more than willing to expand their operations. Prices of all steel products were at such moderately low levels as to be attractive to buyers and many anticipated their requirements freely. Makers of steel, on the other hand, were unwilling to commit themselves for any extended period, believing that the second quarter would bring a further advance in price. All these circumstances had in them the making of a strong situation. Mill orders took on a satisfactory complexion, in that bookings were limited to tonnage for shipment in the first quarter and a considerable back log was accumulated. Through the first quarter prices of bars, plates and shapes advanced $1 and $2 per ton to the basis of 1.38c. to 1.43c., Chicago.

But buying by the railroads, of which much was expected, as the result of tentative inquiry in January, approximating fully 200,000 tons, failed to materialize except in a limited degree. The greater part of materials purchased consisted of structural shapes, bars and sheets taken by jobbers and fabricators. Rail purchases amounted to about 150,000 tons in the first three months, falling considerably below mill capacity, and car buying, apart from the placing of 5000 to 10,000, inquiry for which was carried over from the old year, was of little consequence. The sheared plate mills have in fact experienced a famine of car plate orders throughout practically the entire year.

ORDERS DIMINISH IN SECOND QUARTER

The effects of this limitation of buying began to appear early in the second quarter, and the mills, gradually at first but with increasing rapidity, found their shipments gaining upon and exceeding their bookings of new business. At April 1 the most favorably situated mill could look scarcely beyond May in planning its rolling schedules and business returned to the status of the last quarter of 1913. No more illuminating evidence could be adduced concerning the continuous and prosperous operation of our steel mills, showing their dependence upon the purchases of the heavier steel products by the railroads, than was presented in the first six months of 1914, a period during which buying from other sources was maintained in almost normal volume. Prices which had advanced gradually weakened in the second quarter, losing all that had been gained. Plates, shapes and bars were quoted at 1.25c., Chicago, by June 1. No. 28 black sheets sold at 1.98c. and No. 28 galvanized at 2.93c.

Following the midyear turning point, the very favorable crop prospect and the expectation that relief was to be provided for the railroad situation became the basis of a much improved sentiment and predictions of large business for the last half were common. Before the close of July came the shock and uncertainty precipitated on the world by the European war and all business was brought to a sudden halt. The long awaited rate decision, for many months the paramount issue, made public the same week, and bringing to the railroads but a fraction of what they had asked, dwindled to insignificance while business sought to fathom the new and forbidding problems of the war situation.

FINANCIAL EFFECT OF THE EUROPEAN WAR

Like the shriveling parchment, flame scorched, credit and circulating currency shrank over night to proportions hopelessly inadequate and intensely discouraging to the expansion of business. Yet immediately there appeared a propaganda for the world-wide extension of United States export trade and predictions of wholesale prosperity for this country, because neutral markets were deprived of their usual sources of supply. The predominating significance of finance in the readjustment was not fully appreciated. Prices which had been advanced in July about one dollar a ton were almost immediately increased an additional dollar, reflecting the uncertainty of producers regarding their future raw material supplies. The anxiety of steel makers concerning their ability to secure ferromanganese in particular became acute. The alloy, which had been selling for less than $40 a ton in this market, jumped to $100 a ton and quotations as high as $150 were reported.

In August, September and October the volume of business steadily declined, and prices, where they were not openly cut, were wholly nominal. During this period much progress was made in meeting the very pressing needs of our financial situation. Demand for supplies for warring nations began to assume large proportions. October and November brought a most favorable change in the balance of trade. But steadily mill operations slumped to the lowest level of activity, the average capacity in operation in this district being under rather than over 30 per cent. By the beginning of December prices unknown in this market for years had appeared, finished steel selling as low as 1.15c., delivered at Chicago and iron bars as low as 0.87½c.

THE PIG-IRON TRADE

To the operators of merchant blast furnaces the year has been even less satisfactory than it has been to steel makers. Including the furnace at Duluth, there are in this district 12 merchant furnaces. During the course of the year the number of these in operation decreased to 3 from a maximum of 9. In blast at the end of the year, were one Iroquois, one Bay View and one Mayville. Even with this reduced productive capacity, very considerable stocks of iron accumulated at furnace yards. The price of Northern No. 2 foundry at the furnace at no time exceeded $14.50, which level was reached in the first quarter of the year, and the greater part of the tonnage marketed was sold at prices at least a dollar less.

The extreme depression of the pig-iron market, which carried the price of foundry iron down to the basis of $12.50 for Northern No. 2, was due to competitive selling in the merchant market by steel company furnaces. This competition was largely in connection with sales of basic iron, nearly all of the important steel foundry tonnage purchased during the year being furnished by steel companies. But, in addition, enough iron suitable for gray iron, malleable and high silicon, requirements was disposed of by non-merchant stacks to exercise the controlling influence in the market. Basic iron in round tonnage for St. Louis delivery was sold by a Chicago district steel company furnace as low as $12.25 at furnace.

Only in the buying movement which began the last week in November did the merchant furnaces have the field of competition to themselves, and prices at that time were raised from $12.50 to $13.50. In contrast, during a buying period earlier in the year the entire purchasing movement exhausted itself without appreciable effect on the price, and in fact a paradoxical situation developed in which the price actually declined as the tonnage of business booked increased, so keen was the competition offered within the district.

SOUTHERN IRON ALMOST SHUT OUT

At the prices which have prevailed throughout the year for Northern iron, pig iron from the South has been able to really compete only in the most favorably located sections of this territory. Such Southern pig iron as has been sold in Chicago proper was placed largely because of the melter's preference and from considerations apart from that of price. The reduction in freight from the South to Chicago, effective at the end of the third quarter, helped not at all, for the reason that Northern producers immediately met the reduction with a cut in their own price. In addition, the application of the new rates was far from clear, in

that the reduction was not made effective over all of the lines, and a number of localities in which there were important foundries continued to carry the previous tariffs.

Despite the disadvantage under which Southern production labored in connection with sales into this territory, prices on Southern iron were maintained very stubbornly throughout the year. As compared with a maximum variation in the price of Northern iron at furnace during the year of $2, the decline of Southern iron did not exceed $1.50, conceding a maximum price of $11 at Birmingham and a minimum of $9.50 in December. Southern producers began to blow out their furnaces even earlier than did the merchant interests of the North.

If the consumption of pig iron in this market during 1914, including all grades, was but 50 per cent. of the normal tonnage, the fact still remains that the normal melt must increase materially to sufficiently tax present producing capacity to sustain a reasonably strong market for pig iron in this district.

THE CHARCOAL PIG-IRON SITUATION

Producers of Lake Superior charcoal iron have held their situation well in hand throughout the year. Advancing their prices with the improvement in the market during the first quarter, they have been able to maintain the level then established throughout the year. Compared on the basis of producing capacity, the charcoal-iron furnaces have moved their product in better volume than have the coke-iron producers.

The stability of the charcoal-iron market has been secured, however, very largely by reason of the limiting of capacity in blast. Out of 11 charcoal furnaces, assuming the Gladstone and Chocolay stacks to be permanently idle, only 2 have been in operation continuously throughout the year. Of these 11, 6 were idle November 1, the five in operation being Antrim, East Jordan, Elk Rapids, Boyne City and Newberry. The blowing out of the Elk Rapids stack at the close of the year hung in the balance during the December pig-iron buying movement when hopes were encouraged that additional furnaces might be blown in with the beginning of 1915.

THE COURSE OF TRADE IN SCRAP

The scrap market at Chicago also has suffered for the lack of demand for raw materials. The year presents a record of steadily declining and exceptionally low prices. Dealings in old material have presented few opportunities for unusual performance and the market has been largely without feature throughout the year.

The susceptibility of the scrap market to influences which suggest the opportunity for speculative effort has shown itself still existent, and more than one effort was made during the year to establish an advance in scrap values without apparent regard for the demand from melters. On the strength of a wave of popular optimism, the closing effort of the year was made in December and it remains to be seen whether the good fortune of an improved finished material market will save for the handlers of scrap the small advance their efforts were able to inaugurate.

COMPARISON OF PRICES

Elsewhere in this issue of *The Iron Age* will be found comprehensive tables giving prices at Chicago of local No. 2 foundry pig iron, Lake Superior charcoal pig iron and leading varieties of old material, covering a long series of years. These tables have been given separately because of their length and also because the information thus given is of such importance as to justify special treatment.

The following tables show the course of prices in the Chicago market, compiled from the weekly reports in *The Iron Age:*

Average Chicago Prices of Pig Iron, 1914

	Northern coke No. 2	Lake Superior charcoal	Southern coke No. 2
January	$13.80	$15.25	$14.85
February	14.00	15.25	14.85
March	14.25	15.25	15.10
April	14.25	15.45	14.85
May	14.06	15.75	14.85
June	13.69	15.75	14.72
July	13.75	15.75	14.60
August	13.69	15.75	14.35
September	13.31	15.75	14.35
October	12.94	15.75	14.00
November	12.56	15.75	14.00
December	12.90	15.75	13.60
Average for year	13.60	15.60	14.46
Average for 1913	$15.95	$16.50	$16.12
Average for 1912	15.32	16.77	16.11
Average for 1911	14.87	16.96	14.80
Average for 1910	17.10	18.67	16.30
Average for 1909	17.49	19.50	17.30
Average for 1908	17.57	20.24	16.76
Average for 1907	24.50	26.56	24.47
Average for 1906	20.43	20.72	19.44
Average for 1905	17.65	17.99	16.66
Average for 1904	14.37	15.50	13.92
Average for 1903	19.25	22.13	18.31
Average for 1902	20.86	23.50	20.10
Average for 1901	15.38	17.50	14.60
Average for 1900	19.47	22.00	18.35

Average Chicago Base Prices of Finished Iron and Steel, 1914

	Common bar iron, cents	Soft steel bars, cents	Structural steel, cents
January	1.10½	1.32	1.35
February	1.12	1.35½	1.38
March	1.14	1.38	1.38
April	1.13½	1.36	1.33
May	1.10	1.30½	1.29
June	1.07½	1.26½	1.28
July	1.03	1.29	1.29
August	1.07½	1.37	1.37
September	1.07	1.38	1.38
October	.99	1.34	1.34
November	.96	1.27	1.27
December	.93	1.189	1.20
Average for year	1.06	1.32	1.34
Average for 1913	1.43	1.55	1.60
Average for 1912	1.32	1.42	1.46
Average for 1911	1.22	1.47	1.50
Average for 1910	1.45	1.62	1.66
Average for 1909	1.43	1.50	1.59
Average for 1908	1.56	1.66	1.82
Average for 1907	1.78	1.77	1.87
Average for 1906	1.71	1.68	1.86
Average for 1905	1.65	1.65	1.78
Average for 1904	1.41	1.50	1.71
Average for 1903	1.65	1.72	1.75
Average for 1902	1.71	1.73	1.75
Average for 1901	1.58	1.58	1.70
Average for 1900	1.75	1.75	2.00

Average Chicago Prices of Old Material, 1914

	Cast borings, net ton	No. 1 railroad wrought, net ton	Heavy cast scrap, net ton	Heavy melting steel scrap, gross ton	Old steel rails, rerolling, gross ton
January	$4.15	$8.70	$10.20	$9.35	$11.10
February	5.37	9.50	10.87	10.50	11.81
March	4.69	9.06	10.37	9.81	11.56
April	4.50	9.00	10.25	9.80	11.50
May	4.50	9.00	10.06	9.69	11.31
June	4.50	9.00	9.75	9.75	11.50
July	4.50	9.00	9.65	9.75	11.50
August	4.50	8.94	9.50	9.69	11.50
September	4.75	8.37	9.19	9.19	10.75
October	4.75	7.87	9.00	8.50	10.00
November	4.56	7.56	8.56	8.06	9.50
December	4.50	7.90	9.00	8.43	9.50
Average for year	4.61	8.66	9.70	9.37	10.96
Average for 1913	$5.36	$10.80	$10.44	$10.90	$13.33
Average for 1912	6.67	12.54	12.29	12.12	14.19
Average for 1911	5.34	11.23	11.08	10.92	12.91
Average for 1910	5.50	12.99	13.32	13.43	16.34
Average for 1909	6.37	13.76	13.79	14.45	15.82
Average for 1908	5.37	12.45	12.69	12.45	14.40
Average for 1907	8.78	14.63	17.26	15.08	17.53
Average for 1906	8.69	15.62	14.55	14.74	17.15
Average for 1905	8.57	16.14	13.50	13.97	15.02
Average for 1904	4.72	12.45	10.95	10.72	12.54
Average for 1903	7.33	16.07	14.75	15.50	19.04
Average for 1902	8.89	19.68	15.03	17.37	23.35
Average for 1901	4.20	15.00	11.25	12.84	16.05
Average for 1900	6.65	15.00	11.00	12.84	15.50

Large deposits of iron sand, containing 8 to 9.2 per cent. titanium, are said to exist on the west coast of the North Island of New Zealand. It is reported that a small blast furnace is to be erected at Plymouth near these deposits. The proposal is to use briquettes made of 60 per cent. of the sand and 40 per cent. of small coal.

The Pittsburgh Iron Trade in 1914

BY ROBERT A. WALKER

The year 1914 in the steel trade will go down in history as being one of the worst from probably every point of view that has ever been known. It seemed that nothing happened that was of direct benefit to the trade, and the record made is one that will be recalled with the hope that a similar twelvemonth may never come again. When the year opened, money was scarce and politics was in a turmoil, the attitude of the National Adminstration being directly hostile to manufacturing interests. The large steel companies booked orders at low prices running through the first quarter and first half of 1914, and whenever prices showed any signs of recovery it was but for a brief period. One of these was in February and another in June. At the latter time it seemed that the steel business was well on the way to satisfactory prices and a heavier demand. Prices were carried up to a slight extent in June and in July but then came the outbreak of the European war, with its financial disturbance and not only the steel business but nearly all other trades were paralyzed. It took several months to recover equilibrium, and in the meantime manufacturing operations fell to a low rate.

The establishing of Federal Reserve banks did much to relieve financial conditions and the National Administration is being universally credited for persisting in this important undertaking, as it is believed that the institution of these banks is one of the best things that have ever been done by the National Government, as it will probably prevent money panics in the future. In the last quarter of 1914, the money situation showed decided betterment, and it was possible late in November and through December to negotiate bank loans at reasonable rates of interest. This helped the situation considerably and released for further negotiations a large number of projects that were tied up when the war started. Sentiment in December was better, and contracts for plates, shapes, bars and tin plate, together with heavy sales of pig iron for first quarter and first half, gave a more encouraging aspect to the situation.

When the European war first started it was impossible to get bottoms for foreign shipment, nor could financial arrangements be made for doing a foreign business. This condition, however, was speedily improved, and in the last three months of 1914 heavy shipments abroad of nearly all kinds of finished iron and steel products were being made. Orders were especially heavy for barb wire and other wire products. It is expected that when the rehabilitation of the belligerent countries starts, after the war is over, their demands will be enormous, and to the United States will probably come the heaviest foreign orders for all kinds of iron and steel products that have ever been known. While the outlook for 1915 not only for domestic but foreign trade is regarded as bright, it is not believed there will be much recovery in prices before the second quarter and possibly not before the second half.

THE COURSE OF THE PIG-IRON TRADE

The pig-iron market all through 1914 was depressed. In January, Bessemer pig iron was selling at $14.25; basic, $12.75; No. 2 foundry, $13, and gray forge, $12.75, all at Valley furnace. The freight rate for the greater part of the year from the Valley furnaces to the Pittsburgh district was 90c. per ton, but on November 1 it was advanced to 95c. In February, on account of some fairly heavy demand, basic iron advanced to $13.25, but this price was maintained for only a short time, the market gradually declining to $12.50 or under, and the year closed with $12.50 ruling. Other grades of iron showed little change throughout the entire year.

The number of idle furnaces steadily increased to the end of the year. In the last six months steel works operated an average of only 35 to 40 per cent. of their capacity and this cut down very much the consumption of pig iron. At the close of the year, the Carnegie Steel Company, which has 59 blast furnaces, was operating only 22 and only 5 merchant blast furnaces in the two valleys were active.

No additions to pig-iron producing capacity were made in the Pittsburgh district in 1914, and no new blast-furnace construction is under way. It is not likely there will be much increase in the output of pig iron very early in 1915, but probably in the second quarter the demand for finished steel will have increased to such an extent that it will be necessary to make more pig iron.

The following table gives the monthly prices in 1914, averaged from weekly reports in *The Iron Age*, of Bessemer, basic, No. 2 foundry and gray forge iron, f.o.b. Valley furnace, to which 90c. a ton should be added for delivery in the Pittsburgh district up to October inclusive and 95c. for November and December:

Average Monthly Pig-Iron Prices, f.o.b. Valley Furnace, 1914

Month	Bessemer	Basic	No. 2 foundry	Gray forge
January	$14.10	$12.50	$12.85	$12.75
February	14.19	13.19	13.19	21.75
March	14.19	13.00	13.25	12.75
April	14.00	13.00	13.25	12.75
May	14.00	13.00	13.00	12.75
June	14.00	13.00	13.00	12.75
July	14.00	13.00	13.00	12.75
August	14.00	13.00	13.00	12.75
September	14.00	12.94	13.00	12.75
October	13.95	12.80	12.90	12.68
November	13.64	12.47	12.75	12.50
December	13.75	12.50	12.75	12.45

THE TRADE IN STEEL BILLETS

The year opened with but a moderate demand for steel. Bessemer and open-hearth billets were quoted at $20, and Bessemer and open-hearth sheet bars at $21, f.o.b. Pittsburgh mill. There was not much change in prices during the year, except that in February and June there were slight advances due to a little better demand. From July, and particularly after the European war started, the demand for Bessemer and open-hearth billets and sheet bars steadily declined, and steel works were only able to operate at 35 to 40 per cent. of capacity. Prices continued low through the last half and at the end of the year Bessemer and open-hearth billets were selling at about $19 and Bessemer and open-hearth sheet bars $20, f.o.b. Pittsburgh mill, for delivery in first quarter of 1915. Prices f.o.b. cars at Youngstown mills were about $1 per ton under these figures.

Little new construction work was undertaken, the only new steel plant in the Pittsburgh district that was added being that of the Brier Hill Steel Company, Youngstown, Ohio, containing seven 75-ton furnaces. The Central Steel Company is building an open-hearth works at Massillon, Ohio, consisting of three 60-ton furnaces, blooming mill and sheet bar mills, which is expected to be making steel about April 1, 1915. Other steel companies that have made slight additions to their capacity in 1914 include the West Penn Steel Company, Brackenridge, Pa., which added one 100-ton open-hearth furnace; the West Leechburg Steel Company, Leechburg, Pa., which added one 40-ton furnace, and the N. & G. Taylor Company, Cumberland, Md., which added a 25-ton furnace.

THE STEEL-RAIL TRADE

The year was probably the worst from the point of demand that the steel-rail trade has ever known. At

no time were the three rail mills at the Edgar Thomson works of the Carnegie Steel Company able to run to more than about 50 per cent., and there were times in the last half of the year when no rails whatever were being made there, the sole output being sheet bars. The price of standard section Bessemer rails was maintained steadily throughout the year at 1.25c., and of open-hearth 1.34c., f.o.b. Pittsburgh. The demand for light rails was also dull, especially from the coal-mining companies. In the last half of 1914, the coal business was very dull, prices were low and the mine operators practically stopped new work and cut down expenses in every direction. The demand for light rails therefore fell off heavily, and prices dropped correspondingly.

THE TRADE IN STRUCTURAL MATERIAL

The demand for structural shapes in the first half of 1914 was fairly heavy, but in the last half was so dull that prices declined sharply. At no time were the fabricating shops able to operate to full time, and in the last four or five months general operations were not over 40 to 50 per cent. In fact, one month the Bridge Builders' and Structural Society reported that only 26 per cent. of the capacity of the fabricating shops was active.

The year opened with beams and channels up to 15-in. ruling at 1.20c., Pittsburgh, which was the high mark reached in the year. From time to time the market declined and several attempts to hold to 1.20c. failed because of the light demand. At the end of the year heavy beams and channels were quoted as low as 1.05c. for prompt shipment.

THE STEEL-PLATE TRADE

The demand for steel plates was much less than in 1913. In the first half of the year considerable car building was in progress and the plate mills were able to operate to 60 to 75 per cent. of capacity. In the last half, and particularly after the European war started, the building of new cars having practically stopped, plate mills were able to run only to about 25 to 35 per cent., and in some cases less. The year opened with steel plates selling at 1.20c., Pittsburgh, but at no time did the price rise higher than this and most of the year it was lower. In the last four or five months plates sold at 1.05c. to 1.10c., and in a few cases 1.02½c. was done. No additions to plate mill capacity were made during the year in the Pittsburgh district.

THE TRADE IN STANDARD PIPE

Tubular goods in the first half of the year enjoyed a reasonably good demand. The trade in the last half dropped off, in common with other products, and in the three or four closing months of 1914 the pipe mills were not running to an average of more than 35 per cent. A reduction of about $1 per ton in the price of steel pipe was made November 2, 1914, but prices on wrought-iron pipe were well maintained the whole year. Some projects in which large quantities of line pipe would have been used were held up after the European war started, owing to the tight money situation, but it is believed that some of these will be taken up again early in 1915.

[Sheets and tin plate are considered under a special heading elsewhere in this issue of *The Iron Age*.]

COURSE OF TRADE IN OLD MATERIAL

At no time in the year was the demand from consumers active for iron and steel scrap. The high mark in prices was reached in January and February. They declined sharply in March but until July did not fluctuate much. The demand was dull as the steel works were running so much below their capacity. After the European war started, prices of scrap further declined. The low mark was reached in November, at which time heavy melting steel scrap sold at $10 or under, bundled sheet scrap $8, rerolling rails $11.50 to $11.75, borings $7.50 to $7.75 and turnings $7.25 to $7.50. In December prices recovered somewhat with an improvement in the demand. The following table shows monthly prices on the kinds of scrap noted, averaged from weekly market reports in *The Iron Age*, as follows:

Average Old Material Prices, Gross Ton, Pittsburgh, in 1914

	Heavy steel scrap	No. 1 foundry cast	Bundled sheet scrap	Re-rolling rails	Cast-iron borings	Machine-shop turnings
January	$13.62	$10.75	$6.80	$13.05	$7.80	$8.87
February	12.62	11.69	9.12	13.81	8.94	8.75
March	12.12	11.50	8.69	13.25	8.44	8.12
April	12.00	11.50	8.50	12.80	7.75	7.55
May	12.00	11.50	8.75	12.75	7.81	7.66
June	12.00	11.37	8.56	12.75	8.19	7.75
July	12.00	11.45	8.35	12.70	8.25	7.75
August	11.50	11.25	8.25	12.50	8.25	7.75
September	11.31	11.25	8.25	12.69	8.25	7.75
October	10.85	11.45	8.25	12.15	8.44	7.75
November	10.00	10.50	8.00	11.75	7.79	7.39
December	10.75	10.80	8.55	11.75	7.95	7.45

REVIEW OF THE COKE TRADE

In the first three or four months of 1914 the demand for both furnace and foundry coke was quite active. Prices of furnace coke were then ruling at $1.75 to $1.85 per net ton at oven for prompt and $2 on contracts. Best grades of 72-hr. foundry coke were about $2.50 for prompt and $2.60 on contracts. These were the high prices reached. In May and June the demand fell off and before November the output of coke in the upper and lower Connellsville regions reached the smallest point in recent years. Early in December some large contracts for blast-furnace coke were closed for first half and for all of 1915 at $1.75 flat per net ton at oven.

The following table shows monthly prices, per net ton at oven, on prompt and contract furnace and foundry coke during 1914, averaged from weekly quotations in *The Iron Age:*

Average Monthly Prices, Per Net Ton at Oven, of Connellsville Coke in 1914

	Prompt furnace coke	Contract furnace coke	Prompt foundry coke	Contract foundry coke
January	$1.85	$2.00	$2.50	$2.58
February	1.85	2.00	2.50	2.50
March	1.90	2.00	2.45	2.45
April	1.86	2.00	2.30	2.40
May	1.77	1.92	2.36	2.40
June	1.75	1.85	2.25	2.32
July	1.75	1.84	2.15	2.22
August	1.70	1.75	2.15	2.25
September	1.65	1.75	2.09	2.10
October	1.60	1.75	2.00	2.00
November	1.52	1.75	1.92	1.92
December	1.50	1.75	1.94	1.90

The outlook for the coke trade in the first quarter and probably first half of 1915 is not very bright, as it will take a large increase in demand for pig iron before orders for coke will improve.

The ninth annual banquet of the Brown-Wales Company was held on the evening of December 30 at the Harvard Club, Boston, Mass. All the officers, salesmen and office force were present, numbering 26. The opening remarks were made by the president, William Q. Wales, who welcomed his associates with kindly expressions well calculated to impart good feeling to the assemblage. The business was established 44 years ago, for nearly 40 of which Mr. Wales has been a leader. The guest of the evening was Robert E. Sargent, New England manager of the Standard Sanitary Mfg. Company, Pittsburgh, Pa., who delivered a very interesting and instructive address. It was the most enjoyable dinner yet held by the company.

The placing of machines, having to do with free aisles and the desirability of not overcrowding in machine shop operations, is the subject of an article in the October issue of the publication of the Travelers' Insurance Company, Hartford, Conn.

The Philadelphia Iron Trade in 1914

BY CHARLES LUNDBERG

The manufacturers and merchants of this district regard with relief the passing of 1914. It will be remembered as a poor year. At the beginning, the troubles in Mexico were considered a serious political disturbance and the tariff changes were a serious economic disturbance; throughout the year the inactivity of the railroads in buying restricted iron and steel operations. Then came the European war, which for a time prostrated international commerce and left it crippled at the end of the year. The trade to-day believes that the outlook is brighter than it was a year ago. The war, though a damper on the world's trade, has worked some benefit in that it checked the threatened invasion of our markets by foreign mills and created a demand from abroad for no small number of metal products, though it must be admitted that exports of iron and steel have been disappointing. The Eastern railroads already are showing more disposition to buy, since they were granted their application to advance freight rates. The indications are that shipbuilding will increase. Barring two or three flurries, in which the market grew stronger, the general tendency of prices in 1914 was downward.

IRON ORE

The ore market was dull without variation. Ore accumulated on old contracts, consumption was light for months and there was little indication of future need. Not a little ore was carried over from 1913 and at the end of 1914 again contracts were extended. Importations in the year included 45,659 tons of El Capitan (African) ore, 100,000 tons of which is under contract for delivery this year. From Cuba there arrived 30,100 tons of El Cuero ore and from Spain 7777 tons of Bedar ore. In the year 37,905 tons of Wabana ore arrived from Newfoundland. Through one agent 37,136 tons of Spanish ore was brought in and 6500 tons is under contract for delivery this month. About 800,000 tons was the total imported, or about 500,000 tons less than in 1913. About 315,000 tons was Cuban, 40,000 tons Chilean, 286,000 Swedish and the remainder miscellaneous. The first cargo of Chilean ore consigned to the Bethlehem Steel Company arrived June 7 and was followed shortly by others. The mining of Wabana ore was interrupted by the war and deliveries to German buyers were stopped. Had there been a big demand, high ocean freights and scarce bottoms would have been a hindrance to importation.

PIG IRON

The most sustained active period of the year was in the first quarter, though in November and early December there was a big movement. The trend of prices was steadily downward from the level of $15, delivered for eastern Pennsylvania No. 2 X at the beginning of January and that the dwindling prices meant actual losses was an assertion frequently heard. The quotation at the end of December was $14.25 to $14.50 delivered. The accompanying table shows the monthly averages of minimum quotations for the principal grades of pig iron delivered in buyers' yards, eastern Pennsylvania and nearby points:

Average Prices of Pig Iron, Delivered in Buyers' Yards, Eastern Pennsylvania and Nearby Points, in 1914

	Penna. No. 2 X	Virginia No. 2 X	Standard gray forge	Basic	Standard low phos.
January	$14.72	$15.55	$14.05	$14.00	$21.00
February	14.94	15.55	14.00	14.12	21.00
March	15.00	15.55	14.00	14.06	21.00
April	15.00	15.55	14.00	14.25	21.00
May	14.81	15.55	13.81	14.06	21.00
June	14.75	15.55	13.75	14.00	20.62
July	14.75	15.50	13.75	14.00	20.50
August	14.75	15.30	13.75	14.00	20.75
September	14.75	15.30	13.75	14.00	21.00
October	14.65	15.28	13.65	14.00	20.90
November	14.50	15.25	13.50	14.00	20.00
December	14.25	15.25	13.50	13.50	20.00

Twice in the year the Philadelphia territory was invaded by Buffalo interests who booked a large volume of orders in both instances at prices close to $12, furnace.

In January there were 18 furnaces in blast in Eastern territory and in December but 12. The stocks of pig iron on hand at Eastern furnaces, not including Virginia, were highest in February, having increased 12 per cent. over those of January. Then came a steady decline until in October they were 66 per cent. of the January total. The December total was 81 per cent. of the January total, having increased from October because of the usual tendency of consumers to take as little metal as they can just prior to stock-taking periods.

The December stocks of Virginia iron showed an increase over those of January of slightly less than 79 per cent. The accumulation on furnace banks was steady throughout the year, the February increase being aproximately 14 per cent., while the total in October showed a gain of about 73 per cent. over the January total. Virginia iron was steady at $15.55, Philadelphia, for No. 2 X in the first seven months of the year, then dropped to $15.30 and again in October to $15.25, both declines being partly due to reductions in freight rates.

In the spring there was delivered to Delaware River pipe foundries several thousand tons of Nova Scotian pig iron, the plan being to bring down about a cargo a month in the season of navigation, later bringing higher foundry grades. The experiment was not altogether successful because of declining demand and low prices. The last shipment, 3000 tons, arrived in September. About the middle of May there was a heavy movement in basic, the quantity taken being estimated at 80,000 tons, buyers paying $14, delivered. This buying stimulated the entire market and June was the best month of the year up to that time in general iron buying. Of interest in October was the appearance of a Delaware River company as a maker of low phosphorus iron, but only a small quantity was sold and late rumors are that the producer will cease making this grade of iron.

BILLETS, PLATES AND SHAPES

At the beginning of 1914 makers of steel billets were slow in making contracts for open-hearth rolling billets at $21.50 to $22.40, delivered to eastern Pennsylvania consumers. Again this was their attitude at the end of 1914, when $21.40 was the price, but subject to concessions. At no time in the year were the mills really rushed, and in January and in nearly all of the last half of the year operations were on part time only. Thousands of tons of cold billets were accumulated, and with one mill these were used for weeks while the open-hearth furnaces were shut down. In February there was some improvement and $23.40 to $24, delivered was quoted. In April $22.40 was again quoted. In July, with the mills operating at 50 per cent. or less of capacity, $21.90 was quoted. In August $22.40 was quoted and later in the same month $23.40, following an increase in demand which led the trade to believe that perhaps the turn in the tide had come. It had not. Foreign inquiry came out in August and later some business developed from it, but not a great deal. In October $22.40 delivered was quoted and in November $21.40.

Plates were hard hit by the failure of the railroads to buy cars and locomotives, while the building of but few ships was another bad feature. Competition in plates was keen, particularly in the last half, when

1.05c., Pittsburgh, and even lower was done. A good tonnage of shapes was booked in the early part of the year, which served to bring the average output up to a fair level, but the average of prices could not make as good a showing. The last half of the year was dull with a dearth of building and bridge work, and at the end of the year makers were again unwilling to book contracts at prevailing prices. At the beginning of 1914 they were faced with 1.35c. delivered. At the end of the year 1.20c. was being done on prompt business and contracts asked for at that level. The mills, however, refused to take less than 1.25c. for first quarter and 1.30c. for second. In April 1.30c. was done and in May 1.25c. In August came a wave of better demand and 1.35c. delivered was quoted. Then came successive declines to 1.05c. In the year a new plate mill was finished and placed in operation, but it was only operated intermittently.

SHEETS AND BARS

The demand for sheets was of the hand-to-mouth order in the great part of the year and the course of prices was generally toward lower levels. No. 10 blue annealed sheets in January were quoted at 1.55c., delivered here; in May at 1.50c.; in August at 1.65c.; in September at 1.60c.; in October at 1.55c.; in November at 1.50c., and in December at 1.45c. on prompt business. In the spring Eastern makers reduced their prices on the Pacific coast to meet foreign competition which faded away when the war paralyzed imports of all kinds. In late July and August the market was better, but it did not sustain the hope that a permanent change had come.

Steel bars suffered a net loss of $3 a ton in the year, the quotation in January being 1.35c., Philadelphia, and in December 1.20c. The decline in prices was without interruption until June, which month made the best showing of any since February. In August the market strengthened again until steel bars were quoted at 1.35c. Then came declines to 1.30c., to 1.25c. and in December to 1.20c. Iron bars opened the year at 1.22½c. and closed at 1.17½c. In May efforts were made to import German steel bars, but importations which were examined here and at New Orleans were found to be so badly finished, crooked and rusted as to be practically unsalable.

OLD MATERIAL

While the market was fair and prices not only sustained but advanced in the first few months of the year, old material eventually joined the common trend and lost in strength. At the beginning of January No. 1 heavy melting steel was quoted at $10. In March and April there were extremely heavy sales at between $11 and $11.50. A downward tendency then set in. By August the quotation was down to $9.75, the lowest in many years. In the latter part of the year over 7000 tons of scrap from the Isthmus of Panama was offered here and not only proved a glut on the market but had a large share in bringing down the price. August later brought some improvement and the price went to $11.75, after which the decline was resumed. In November the price of No. 1 heavy melting steel was down to $9.25. Altogether the scrap merchants pronounced the year a poor one in which less tonnage had been moved than in the previous year. The range of quotations, showing the monthly average minimum price for the leading grades, delivered in buyers' yards in this territory, taking a freight rate varying from 35c. to $1.35 per gross ton from Philadelphia is given in the accompanying table, the average prices for 1912, 1913 and 1914 being given in the closing columns.

Average Prices of Old Material, Delivered in Buyers' Yards, Eastern Pennsylvania, in 1914, per Gross Ton

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average 1914	Average 1913	Average 1912
No. 1 heavy steel	$10.40	$11.00	$11.31	$10.95	$10.63	$10.50	$10.30	$10.19	$10.69	$9.95	$9.25	$9.40	$10.38	$11.97	$13.59
Low phos. steel	14.00	14.50	14.50	14.50	14.50	14.38	14.00	14.00	14.00	13.80	13.50	13.50	14.10	16.31	16.85
Iron rails	15.60	16.50	16.50	15.70	15.25	15.00	14.60	14.00	14.00	13.60	13.00	13.00	14.75	17.56	16.58
No. 1 railroad wrought	13.05	14.38	14.00	13.25	12.63	12.50	12.20	12.00	12.38	11.80	11.50	11.50	12.60	14.49	15.57
Carwheels	12.20	12.63	12.50	12.00	11.75	11.19	11.00	11.25	11.25	10.10	9.50	10.00	11.28	13.51	13.73
Wrought-iron pipe	9.50	11.00	10.69	10.45	9.88	9.38	9.25	9.88	10.75	9.80	9.50	9.50	9.96	11.39	12.75
Machine shop turnings	7.30	9.00	8.75	7.90	7.50	7.69	7.75	7.94	8.56	7.90	7.50	7.65	7.95	8.74	10.27
Cast borings	7.80	9.19	8.94	8.30	8.00	8.00	8.00	8.50	8.56	8.00	7.50	7.65	8.20	8.79	9.64
No. 1 cast	12.00	12.88	13.00	13.00	12.25	12.00	12.00	12.00	12.00	11.40	11.00	11.30	12.07	13.38	13.84
Stove plate	9.25	10.00	9.75	8.95	8.63	8.50	8.35	8.25	8.44	8.20	8.00	8.00	8.69	9.86	12.28
Railroad malleable	9.30	10.00	9.75	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.17	11.85	10.36

The Cincinnati Iron Trade in 1914

BY CHARLES L. SMITH

Both producers and consumers of pig iron witnessed the passing of 1914 with a feeling of relief. From a furnace standpoint the year was very unsatisfactory. Up to November 30 the average decline in the price of Southern iron was approximately $1 per ton, and figures for December show a still further decline of 50c., making the minimum Birmingham quotation on No. 2 foundry $9.50 at the end of the year. As the cost mark was said to have been reached previously by Hanging Rock producers, the general average for the entire year is close to $13, Ironton, which includes a drop of 25c. per ton made early in December.

The foundry melt in this territory was much below normal, with the exception of a few weeks of activity at the beginning of the year. An exception may be made also of the jobbing foundries making a specialty of machine-tool castings for local and nearby plants, which received a large number of orders from Europe, on account of the war, during the last three months of the year.

FIRST QUARTER'S PIG-IRON TRADE

As is usual at the beginning of the year, pig-iron inquiries were very light the first week in January. Transactions were confined to carload lots, and the price of Southern No. 2 foundry was $10.50, Birmingham. A better inquiry came to light about the middle of the month, most of which was from Indiana and Michigan melters. An endeavor to stiffen prices was made, which was partially successful, but at the wind-up of the month quotations were the same as for the first week. Northern iron was held steadily at $13, Ironton. Only a few sales of foundry iron were reported, but a nearby rolling mill bought 20,000 tons of basic for first half shipment. A pipe manufacturer also contracted for a round tonnage of Southern iron.

A number of sales were quietly made the first two weeks in February, but melters, as a rule, did not show any disposition to contract ahead. The same condition practically prevailed through the entire year, but this experience in February was probably brought about by

the reluctance of both Northern and Southern furnaces to open their books for last half business. Some ferromanganese was bought in this territory at $36, seaboard. The silvery irons were active and a number of contracts were closed at $16 at furnace, based on an 8 per cent. analysis.

Little business was transacted the first week in March, as violent snowstorms interrupted all lines of communication. An Ohio manufacturer closed for 4000 tons of Northern foundry and 2000 tons of Southern iron for shipment in the first half of the year, and it was reported that the regular quotations were shaded by the seller in order to close the contract. The Hanging Rock furnaces made a successful attempt to advance prices 50c. per ton the latter part of the month, but few contracts were closed at the higher figure. A few Jackson County silvery iron furnaces reported minor labor troubles at their plants, but all differences were adjusted before the month was up.

SECOND QUARTER GENERALLY DULL

Both April and May were exceedingly dull months. Buyers and sellers both seemed content to await developments, and, as a consequence, comparatively little business was transacted. Malleable showed some signs of awakening, but the largest sale made in this territory was of only 2000 tons for nearby shipment. Southern iron weakened somewhat, and several furnaces made open quotations of $10.50, Birmingham, for any shipment to July 1. The reduction in the schedule of prices for Lake Superior ores, made early in May, excited no interest here.

In June there was a slight increase in foundry-iron inquiries, and the resultant competition for business brought about a softening of prices. A number of Southern iron contracts were made at $10.25, Birmingham, with shipments extended through the third quarter, and in a few instances through the entire year. Tennessee furnaces were blamed for shading quotations, but Alabama operators were also involved. Some resale iron is also said to have changed hands the latter part of June at $10 at furnace.

THIRD QUARTER'S TRADE UNSATISFACTORY

July was not a satisfactory month from a tonnage standpoint, but a large number of small orders were placed, mostly for Southern foundry iron, the price of which was reduced to $10, Birmingham, for prompt shipment, and in some cases this price was inserted in last half contracts. Competition from Lake furnaces became keen in sections of central Ohio, Indiana and Michigan. A Chicago furnace took an order for foundry iron as far south as Evansville, Ind. In self-defense, Ironton producers were forced to reduce prices, and as low as $13 at furnace was done toward the end of the month, but this quotation was not general and was on a special lot of speculative iron that was put on the market by its purchaser for prompt shipment. However, early in August the furnaces came out flat with a $13 price for any delivery through the year. The war in Europe caused a withdrawal of all quotations on ferromanganese, and much uneasiness was manifested by the rolling mills as to the probability of the supply being cut off entirely.

The announcement of the railroads that through bills of lading would be issued on shipments to Europe, with the exception of Germany and Austria, had a stimulating effect on the machinery trade early in September. During the latter half of the month a number of orders were received from both France and England for medium-sized lathes, and this was the commencement of the improvement with the jobbing foundries noted above.

Apropos of the machine-tool situation, the subjoined table prepared by J. M. Manley, secretary of the Cincinnati Branch, National Metal Trades Association, shows the percentage of activity of members of this association as far back as June 15, 1907, which ended the most active three months in the history of the organization. The reports are based on the comparative number of employees at work in the various members' plants. On account of the war business above mentioned the report for the quarter ending March 15, 1915, is expected to be more satisfactory.

Percentage of Productive Capacity Active in the Cincinnati Metal Trades

1907	Per cent.
June 15	100
September 15	97
December 15	85
1908	
March 15	67
June 15	56
September 15	53
December 15	56
1909	
March 15	62
June 15	65
September 15	72
December 15	83
1910	
March 15	89
June 15	92
September 15	91
December 15	91

1911	Per cent.
March 15	91
June 15	87
September 15	85
December 15	83
1912	
March 15	82
June 15	84
September 15	88
December 15	93
1913	
March 15	97
June 15	99
September 15	90
December 15	95
1914	
March 15	81
June 15	87
September 15	77
December 15	65

LAST QUARTER'S TRADE IMPROVED

On October 1 the reduction in freight rates on pig iron from the South to various points in Central Freight Association territory went into effect, making the rate from Birmingham to Cincinnati $2.90, instead of $3.25 per gross ton. This action necessarily put the Hanging Rock furnaces at a still greater disadvantage, which was further intensified on November 1 when the rate from Ironton to Central Freight Association points was increased 5 per cent., or from $1.20 to $1.26 per ton to Cincinnati. During the latter part of October and through November contracting of foundry iron for first quarter and first half shipment was made at prompt shipment quotations. The tonnage involved was said to have been quite satisfactory, though not up to normal for the season. This buying extended well into December. In the scramble for orders prices again suffered, Southern iron being offered as low as $9.50 for first half shipment, while $12.75, Ironton, could easily be done on Northern iron. There was little interest taken in either malleable or basic.

The granting of the 5 per cent. advance to Eastern railroads, for which they have been contending for some time, together with the large orders for machine tools still coming in from Europe, have not been without a beneficial effect. Widely divergent opinions are entertained by iron merchants, but expressions generally are optimistic as to the outlook for the coming year.

The following table shows the range of Cincinnati prices on leading grades of pig iron and scrap, averaged from weekly quotations in *The Iron Age:*

Average Prices of Pig Iron and Scrap at Cincinnati in 1914

	Southern No. 2. Gross ton	Northern No. 2. Gross ton	No. 1 railroad wrought. Net ton	Railroad cast scrap. Net ton
January	$13.85	$14.20	$8.20	$8.45
February	13.81	14.20	9.31¼	9.81¼
March	14.00	14.51½	9.31¼	9.81¼
April	13.80	14.70	9.05	9.55
May	13.75	14.70	8.81¼	9.31¼
June	13.37	14.70	8.75	9.25
July	13.30	14.45	8.75	9.25
August	13.25	14.20	8.75	9.25
September	13.25	14.20	8.31¼	9.25
October	12.90	14.20	7.85	9.10
November	12.80	14.26	7.50	9.00
December	12.50	14.01	7.49	9.20

From the books of a leading pig-iron commission house are taken the subjoined invoice prices on South-

ern No. 2 iron, f.o.b. Birmingham, shipped in the 12 months beginning with December, 1913:

December, 1913	$11.341	July, 1914	$10.388
January, 1914	11.192	August	10.403
February	11.130	September	10.263
March	11.016	October	10.239
April	10.832	November	10.065
May	10.862	December, to 16th	10.005
June	10.677		

As will be understood, a considerable tonnage of this iron was shipped on old contracts made at higher prices than prevailed in the month of delivery.

THE SCRAP TRADE

All classes of scrap iron steadily declined through the year, with the exception of February and March, when large tonnages were taken by the rolling mills and foundries. The improvement in prices then felt was short lived, and April witnessed a decline that was not checked until October. December reports were more encouraging, and a slight advance was made in that month.

The Sheet and Tin-Plate Trades in 1914

BY B. E. V. LUTY

The sheet and tin-plate mills had rather an unsatisfactory year in 1914, prices having been low and the tonnage relatively light. The sheet output fell considerably below that of 1913 and still further below that of 1912. The tin-plate output increased in 1914 over 1913, but still fell well below the record output of 1912.

The unsatisfactory prices obtained in 1914 were due entirely to the competitive conditions, and in nowise to unfortunate fluctuations in raw material costs that have sometimes played havoc with profits. The mills were not caught with their finished product sold at low prices, and a rising market in their raw materials. As to the tin-plate mills, if their sales contracts for 1914, made late in 1913, had held good their profits would have been eminently satisfactory, since prices of steel and pig tin fell after the tin plate was sold, and there is reason to believe that in the main the mills would have profited by these declines. Much of the tin plate, however, did not stay sold. While the announced price was $3.40, under date of November 3, 1913, the average realized price in 1914 was much below this.

The averages of open quotations, at Pittsburgh, have been as follows:

	No. 28 black sheets. Cents per lb.	No. 28 galvanized sheets. Cents per lb.	Tin plates, base box, 100 lb.
January	1.86	2.86	$3.40
February	1.95	2.95	3.40
March	1.95	2.95	3.40
April	1.90	2.89	3.39
May	1.85	2.79	3.30
June	1.81	2.75	3.30
July	1.80	2.75	3.30
August	1.88	2.87	3.50
September	1.98	2.97	3.48
October	1.96	2.96	3.25
November	1.88	2.88	3.25
December	1.85	2.80	3.20
Year 1914	1.89	2.87	$3.35
Year 1913	2.21	3.28	3.56

From 1913 to 1914 the declines in quoted prices were thus $6.40 a ton on black sheets, $8.20 on galvanized sheets and $4.20 on tin plate. The greater decline in galvanized sheets than in black sheets was due partly to a reduction in the profit in galvanizing and partly to a decline in the spelter market, the average price of spelter in 1914 being about half a cent a pound less than in 1913, when the St. Louis average was 5.61c. The decline in tin plate indicated by the open quotations does not represent the full decline, as the quoted price was departed from more widely in 1914 than in 1913. Assuming that the decreased cost of steel should affect tin-plate and black sheets equally, the decline in tin plate would have been about 32c. a box, while the average price of pig tin declined about 9c. from 44c. in 1913 to 35c. in 1914, this involving 15c. to 18c. more.

TONNAGE OUTPUT

The production of sheets of No. 13 gauge and lighter, including tin-mill products not intended for tinning, was 1,857,683 gross tons in 1912, the record year, and 1,668,664 gross tons in 1913. The output in 1914 was considerably less than in 1913.

The output of tin and terne plate in 1912 the record year, was 962,971 gross tons, and in 1913 production dropped 15 per cent. to 823,719 gross tons. The 1914 production was about 900,000 gross tons, placing the year midway between 1912 and 1913 in point of tonnage.

NEW CONSTRUCTION

In 1914 the Trumbull Steel Company completed the plant at Warren, Ohio, on which construction had been commenced in 1913, embracing six sheet and six tin mills, and practically completed the erection of an addition, comprising six tin mills, four sheet mills and two mills to be used for either sheet or tin-mill products. In the summer the Jones & Laughlin Steel Company added eight mills to its plant in a remarkably short time, giving this interest a 32-mill plant, the largest single plant in the country. The Follansbee Bros. Company added three sheet mills to its plant, giving it seven sheet mills in addition to six tin mills. The Western Reserve Steel Company, Warren, Ohio, at the close of the year completed a six-mill sheet plant. The Richland Steel Company took over the plant at Mansfield, Ohio, and commenced the installation of three sheet mills and three tin mills, the latter to make tin-mill specialties.

Including the plants just mentioned as being completed, the total number of operative mills in the United States is approximately as follows:

	Sheet	Tin
American Sheet & Tin Plate Company	160	202
Independent	308	176
Total	468	378
Percentage of independent	66	46

In the above totals only the tin mills connected with tinning establishments are included as tin-plate mills, tin mills connected with sheet plants and making tin-mill specialties being classed as sheet mills, and in the sheet-mill totals jobbing mills are also included. It should be noted, however, that the Chester plant of the American Sheet & Tin Plate Company, while officially listed in the tin-plate department, has no tinhouse.

THE PROSPECTS

The tin-plate prospects for 1915 are excellent. Stocks of canned goods throughout the country are reported as light, the stocks of cans are known to be unusually small, and the tin-plate consumers have short stocks, with a few exceptions. The mills have very scanty stocks. They have been making stock plates to an extent in December, but their stocks on January 1 are much below the average of former years.

The lightness of mill stocks at this time is accounted for partly by the fact that it is much more difficult than formerly to make up stocks, on account of the greatly increased number of common sizes, and the frequency with which large consumers change their specifications. Even when no change is made in the size of

blanks, changes are sometimes made in the number cut from a sheet. For years there was no thought of cutting tin-plate to sizes between the quarter inches, but now eighth inch specifications are common, and some consumers have proposed making up specifications to sixteenths, a proposal which the mills have valorously resisted.

The outlook for tin-plate consumption in 1915 is regarded as particularly good, both from the condition as to stocks of canned goods and the exceptional demand promised on account of the European war. While the tin plate has been sold at a low price, the margin of profit should be greater than in 1914, provided the mills can obtain their raw materials at approximately the prices ruling when the tin plate was sold.

The prospects for the sheet industry cannot be discussed in detail, as the demand for sheets will depend chiefly upon general industrial conditions. That the tonnage will be greater than in the exceptionally poor year 1914 seems to be almost a foregone conclusion.

Metal Market Features of 1914

BY CHARLES LUNDBERG

The copper market made a poor showing at the end of December, 1913. The domestic deliveries of that month were but 21,938,570 lb., a decline of 26,718,288 lb. from those of the preceding month, which in turn were below normal. As will be seen in the subjoined table, which carries the figures of the Copper Producers' Association until they were discontinued in June, domestic deliveries improved in the first four months of 1914 (except in February) after which they slumped again. But business was not good prior to the European war, a situation with which the reduced tariff had much to do, while another disturbing influence was the situation in Mexico.

Producers' Statistics of First Six Months of 1914 in Pounds

	Production	Domestic deliveries	Deliveries for export	Surplus stock at first of month
Jan.	131,770,274	47,956,955	87,955,501	91,438,867
Feb.	122,561,007	47,586,657	83,899,183	87,296,685
Mar.	145,651,982	69,852,349	89,562,166	78,371,852
Apr.	151,500,531	63,427,633	82,345,216	64,609,319
May	142,308,287	55,592,170	72,710,477	70,337,001
June	141,345,571	46,227,353	73,350,196	84,342,641
July	.....	.....	.....	106,110,633

Export deliveries were heavy in the first four months of 1914. Those of March, 89,562,166 lb., were the highest on record, the previous high record having been 88,104,075 lb. in December, 1910. The heavy exports gave rise to conjecture as to whether all of the metal being shipped was for immediate consumption or going into stock. The production in April, 151,500,531 lb., established a new record for monthly output. The production figures in March and May were large also, as the table shows. Any discussion of copper statistics after the cessation of the monthly reports of the producers' statements must of necessity be general and fragmentary. Subsequent to the outbreak of the European war, when trouble arose over exports supposedly destined for Germany, the United States Government withheld for one month figures showing exports. Toward the end of August the mines began to curtail production, but refinery production was not affected until about 30 days later, after which the output was understood to be on a 50 per cent. basis.

Between January 1 and November 30 the stock of copper in Europe (and afloat thereto from Chili and Australia) increased from 29,520 tons to 35,749 tons and this in spite of the heavy drain to which the war must have subjected stocks. The imports into England in November, according to British Board of Trade returns, were 16,018 tons and in 11 months of 1914 were 183,268 tons. In the same period of 1913 the imports were 146,763.

Perhaps as never before, the year more steadily presented what is called a buyers' market. Consumers took hold as compelled by their needs, but they stopped buying quickly when the sellers attempted to capitalize the increasing activity. The consumers may have needed the metal, but there was a limit to what they could afford to pay for it. The general tendency of the first 10 months was one of decline in prices. The average monthly prices of electrolytic and Lake are shown in tabulated form elsewhere. The changes in the base price of hot-rolled sheet copper given below afford an interesting index to the course of copper prices.

Prices of Hot-Rolled Sheet Copper

January 1	20¼c.	September 1	17½c.
February 2	20c.	October 1	17c.
March 13	19¾c.	October 22	16½c.
May 13	19½c.	November 19	17c.
May 22	19¼c.	November 23	17½c.
June 15	19c.	December 1	18c.
July 27	18½c.	December 15	18½c.
August 18	18c.		

The demand for brass and copper products was extremely light in the early part of the year and none too good at any time. The mills ran but three or four days a week in some months. In April the prices of brass and copper tubes were reduced 3c. per lb. to meet foreign competition.

About July 15 the quotation for electrolytic was 13.50c. cash, New York. Shortly afterward, signs that the European war was brewing caused the market to touch 13c. July 28, it was down to 12.50c., and by September 18 down to 11.87½c. The chief feature of September was the action of Great Britain in placing copper on its list of conditional contraband. (Later it was placed on the list of absolute contraband, with copper wire and other products.) The British seized American-owned metal in Holland in September, but paid for it. Subsequently a number of ships bound for North Sea ports were held up by the British, whose purpose, of course, was to keep Germany and Austria from getting copper.

October 19 electrolytic was down to 11.25c. cash, New York. In the latter part of October occurred the heaviest buying of many months, some of which was in behalf of Germany despite the attitude of Great Britain. Then came the seizure of several ships with copper in their cargoes, bound for Mediterranean ports, action which later was the subject of a protest to the United States Government on the part of a number of the producers and a later protest to Great Britain by the United States. Some vessels refused, for a time, to accept shipments of copper to Italy.

Considering all the events which hampered trade, exports in the first 11 months of 1914 compared favorably with those of the same time in 1913, the figures being 338,063 tons and 352,157 tons, respectively, a showing which is accounted for by the heavy exports of the early months of 1914. The exports of August were but 16,459 tons as compared with 35,072 tons in the same month of 1913. From August on, exports increased, those of November being 24,999 tons against 29,758 tons in the same month of 1913.

Between November 11 and 17 there was heavy buying on both domestic and foreign account and prices mounted, until the quotation November 18 was 12c., but this did not end the advance and 13.37½c. cash, New York, was reached December 15, after which the market eased off.

Lake copper was quoted January 2 at 15.12½c. cash, New York. Its quotations varied more or less with those of electrolytic, but showed more of a tend-

ency to pursue an independent course than in previous years. In general, prices declined steadily, and 12c. was quoted the first of October and 11.50c., later in the month. From this point prices advanced. Ammunition makers took vast quantities of Lake, for export as cartridge metal, sending the price in December to 13.50c.

TIN

The average of monthly deliveries of tin was good when industrial conditions of the year are taken into consideration. They were as follows:

	Tons		Tons
January	3600	July	3900
February	3300	August	2900
March	4450	September	3600
April	4300	October	3700
May	3800	November	2600
June	3650	December	1900

The first five months of 1914 were not particularly eventful. The highest price in that period was 41c., on February 5 and 11, and the lowest 31.45c., May 29. The general tendency between those dates was one of decline. Sales were made June 15 at 29.50c., the lowest price in years. At the end of July, foreign advices as to the impending war, advances in foreign exchange and fears of a shortage excited the market to fever heat, and with the news that Great Britain had declared war on Germany came a veritable panic. The difficulties in cabling, all codes being barred, added to the excitement. Sales were made at the following prices: August 1, 38c.; August 3, 50c.; August 4, 57c.; August 5, 60c.; August 6, 60.50c.; August 7, 61c.; August 10, 64c.; August 11, 64.25c. There were reports of sales at 68c. and higher and they probably took place, though the lots were small.

Prices quickly tapered off, when consumers realized that they were more scared than hurt, and the price August 21 was 40.50c. Fears that Great Britain would put an embargo on the metal disappeared, and good arrivals brought about a steadier tone. In September it was evidenced that London holders of tin were anxious to realize on their stocks and the market weakened. Uneasiness was then caused by the activity of the German cruiser Emden in the Indian Ocean, but prices continued to decline and on October 16 the market was down to 28.40c. News received October 21 that the Emden had sunk the steamer Trolius with 850 tons of tin helped to stiffen the market, but early in November it was learned that the Emden had been sunk and confidence followed. Arrivals were good in November, but in the following month totaled only 660 tons up to December 31.

A project, which developed after the outbreak of the war, has for its purpose the establishment of a plant to smelt Bolivian tin ore on the Atlantic coast.

LEAD

The quotation for lead on January 2 was 4.50c., New York. It was 4c. or over until March 25, when the price came down to 3.90c., and the 4c. level was not regained again in the year. Early in the year exports of lead began to be notable, the shipments being the first of lead actually mined and smelted in this country in many years. Exportations were stimulated by the high prices which prevailed abroad and when these prices declined exports were lessened. The sales made in May by the largest interest were reported having been the heaviest in its history. At no time was the market upset by the European upheaval, inasmuch as Europe was assisted by the Spanish supply. Great Britain was helped out also by the divergence to her shores of metal which had been intended for the Continent. Competition caused the large interest, on October 5, to reduce its price to 3.60c. New York, and on October 7 to 3.50c. The price was made 3.60c. on November 17 and 3.70c., November 18. Exports were good again in the latter part of the year. The steamer Indrakuala, which cleared for Vladivostok November 14, carried 5417 tons, the largest shipment ever sent from this country.

SPELTER

The New York quotation ranged between 5c. and 6c. throughout the year. The metal suffered from the slower operations of the brass mills and to a lesser extent from the easier demand for galvanized sheets. Producers and sellers profited from the demand created by the war, a notably good demand for the metal and sheet zinc coming in early August from Great Britain, both direct and through Canada.

ANTIMONY

The war brought about strange conditions in the antimony market. Though none is produced in this country, large quantities were shipped to Europe whence most of it had come. Under the unusual demand, quotations advanced sharply from 7c. for Cookson's 6.75c. for Hallett's and 5.50c. to 6c. for other grades (August 5) to 20c. for both Hallett's and Cookson's, and 18c. for other grades (August 12). In the next two months there was a gradual decline, but prices stiffened again in early October on the strength of British demand. Russia also, took large quantities of the metal.

Billet Prices for Twenty-Nine Years

The table below gives the average monthly prices of 4 x 4 in. Bessemer steel billets at Pittsburgh from 1886 to 1914, inclusive. The prices are per gross ton and are averaged from weekly quotations in *The Iron Age*. Prior to 1886 steel billets were not a regular merchant commodity, seldom being mentioned in market reports.

	1886	1887	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900
Jan.	$33.00	$24.50	$29.38	$28.15	$36.65	$25.60	$25.00	$21.56	$16.12	$14.90	$16.80	$15.42	$14.93	$16.62	$34.50
Feb.	33.13	35.44	29.38	27.81	35.25	26.00	24.36	21.62	15.75	14.95	17.38	15.25	15.06	18.00	34.87
Mar.	33.00	36.00	29.13	27.25	31.88	26.25	23.00	22.60	15.55	14.84	17.09	15.44	15.25	24.30	33.00
Apr.	32.00	34.75	28.63	27.00	28.38	25.35	22.81	22.44	15.69	15.44	19.53	14.60	15.06	25.37	32.00
May	30.50	32.38	28.35	26.90	27.55	25.50	22.41	21.69	18.00	16.30	19.50	13.82	14.85	26.75	28.90
June	30.75	31.40	28.06	26.75	30.25	25.25	22.97	21.70	18.12	18.63	19.12	14.06	14.65	30.10	27.25
July	30.33	31.50	28.00	27.13	30.70	25.50	23.50	21.06	18.00	20.75	18.85	14.00	14.50	33.12	21.00
Aug.	30.00	32.50	28.40	28.20	30.38	25.31	23.81	20.45	17.15	21.75	18.75	14.00	15.85	35.40	18.20
Sept.	30.50	31.80	29.00	29.50	30.13	25.00	23.65	19.31	17.19	24.00	19.75	15.60	16.00	38.37	16.93
Oct.	31.63	31.63	29.25	33.70	28.70	24.90	23.53	18.06	16.00	21.90	19.75	16.44	15.56	38.75	16.50
Nov.	32.00	31.00	29.00	34.00	27.39	24.16	24.94	17.37	15.57	19.13	20.00	15.57	15.06	36.50	18.95
Dec.	32.90	29.00	28.44	35.60	26.25	24.20	22.40	16.69	15.12	16.97	17.50	15.00	15.80	33.75	19.75

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	$19.75	$27.50	$29.60	$23.00	$22.75	$26.25	$29.40	$28.00	$25.00	$27.50	$23.00	$20.00	$28.30	$20.13
Feb.	20.31	29.37	29.87	23.00	23.50	26.50	29.50	28.00	25.00	27.50	23.00	20.00	28.50	21.00
Mar.	22.88	31.25	30.62	23.00	24.00	26.70	29.00	28.00	23.00	27.50	23.00	19.75	28.50	21.00
Apr.	24.00	31.50	30.25	23.00	24.00	27.00	30.12	28 00	23.00	26.75	23.00	20.00	28.50	20.80
May	24.00	32.20	30.37	23.00	23.50	26.40	30.30	28.00	23.00	26.12	22.60	20.80	27.60	20.00
June	24.38	32.37	28.87	23.00	22.00	26.63	29.62	25.75	23.00	25.30	21.00	20.87	26.50	19.50
July	24.00	31.75	27.60	23.00	22.00	27.25	30.00	25.00	23.50	25.00	21.00	21.50	26.60	19.00
Aug.	24.20	31.06	27.00	23.00	24.00	27.80	29.25	25.00	24.13	24.62	21.00	22.12	26.00	20.25
Sept.	24.88	29.50	27.00	20.00	25.00	28.00	29.37	25.00	25.00	24.40	20.75	23.62	24.87	21.00
Oct.	26.70	29.70	27.00	19.50	25.62	28.00	28.20	25.00	26.25	23.75	20.00	26.00	23.30	20.00
Nov.	27.00	28.50	24.00	20.25	26.00	28.88	28.00	25.00	27.13	23.30	19.50	27.00	21.00	19.25
Dec.	27.50	29.12	23.00	21.20	26.00	29.50	28.00	25.00	27.50	23.00	19.25	27.00	20.00	19.00

Foundry Iron Prices Cincinnati and Chicago

The tables given below show the average monthly prices of No. 2 Southern foundry pig iron at Cincinnati from 1876 to 1914, inclusive, and No. 2 local foundry pig iron at Chicago from 1888 to 1914, inclusive. These prices are averaged from weekly quotations in the market reports of *The Iron Age* and are per ton of 2240 lb.

Southern No. 2 Foundry Pig Iron at Cincinnati, per Gross Ton

	1876	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888
January	$22.00	$20.00	$18.00	$17.10	$37.75	$22.50	$25.50	$21.62	$17.25	$15.62	$17.00	$20.12	$18.62
February	22.00	20.25	18.00	17.75	41.12	22.50	25.50	21.50	17.00	15.25	17.00	21.00	19.00
March	22.00	20.40	17.62	18.00	38.12	22.50	24.90	20.60	17.75	14.62	17.00	21.00	18.50
April	22.00	20.50	17.75	18.00	33.50	22.50	23.50	20.62	17.87	15.15	17.00	21.00	17.75
May	22.00	20.20	17.00	18.00	26.25	22.25	23.00	20.25	17.25	15.00	16.37	20.50	16.75
June	20.00	20.25	16.25	17.75	23.25	22.00	22.00	19.50	17.25	15.25	16.12	19.40	15.75
July	20.00	19.25	16.00	17.75	22.60	21.50	22.25	19.00	16.62	14.81	15.37	19.50	15.50
August	20.00	18.00	16.20	19.50	24.00	21.50	22.60	18.50	16.00	14.87	15.25	20.00	15.80
September	19.50	18.00	16.75	25.50	24.00	21.75	22.62	18.50	15.87	15.00	16.75	20.00	16.50
October	19.50	18.00	17.00	33.50	23.50	22.00	22.37	18.50	16.25	15.00	17.00	19.75	16.50
November	20.00	18.00	17.00	36.00	22.00	24.50	22.00	18.50	16.18	15.50	17.75	19.50	15.65
December	20.10	18.00	17.00	35.00	22.25	25.00	22.00	18.37	16.25	16.37	18.60	18.87	15.50

	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
January	$14.75	$18.05	$13.81	$13.75	$12.50	$11.00	$9.25	$11.20	$11.00	$9.50	$10.31	$20.69	$13.45
February	14.37	17.75	13.75	13.62	12.12	10.75	9.25	11.00	9.75	9.25	11.69	20.50	13.12
March	14.50	16.00	14.00	13.10	12.00	10.20	9.25	10.75	9.69	9.25	13.75	20.30	14.00
April	14.25	14.31	13.75	13.00	11.75	9.50	9.25	10.40	9.25	9.25	14.50	20.19	14.50
May	14.00	14.25	14.00	12.81	11.68	9.50	9.50	10.50	8.75	9.37	14.56	19.75	13.85
June	13.68	14.75	13.75	12.81	11.50	9.61	10.12	10.32	8.75	9.30	16.00	18.75	13.37
July	14.12	14.75	13.75	12.40	11.37	9.75	11.50	9.75	8.95	9.25	17.56	16.81	13.00
August	14.50	14.75	13.50	12.17	11.05	9.80	11.50	9.37	9.00	9.37	18.35	14.25	13.00
September	14.50	14.25	13.50	12.00	10.75	10.00	12.75	9.50	9.35	9.55	19.94	13.62	13.06
October	15.31	14.25	13.75	12.25	10.75	10.00	12.75	9.95	9.50	9.75	20.75	12.87	13.75
November	16.62	14.25	14.00	12.50	10.75	9.75	12.75	10.44	9.50	9.75	20.75	12.95	14.00
December	17.56	14.00	13.75	12.50	10.87	9.25	12.50	10.35	9.50	9.90	20.75	13.75	14.25

	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	$14.55	$21.65	$12.37	$16.25	$16.75	$26.00	$16.15	$16.25	$17.25	$14.25	$13.25	$16.95	$13.85
February	14.75	21.50	12.12	16.25	16.75	26.00	15.75	16.13	17.06	14.25	13.31	16.69	13.81
March	14.75	21.37	12.10	16.25	16.65	26.00	15.50	15.05	16.30	14.25	13.50	16.31	14.00
April	16.87	20.15	12.50	16.25	16.62	25.06	15.20	14.25	15.37	14.25	13.75	15.65	13.80
May	18.35	18.87	12.25	15.81	16.75	24.25	14.75	14.50	15.00	13.95	14.15	14.94	13.75
June	20.19	17.75	11.80	14.65	16.44	24.10	15.25	14.70	14.85	13.44	14.25	14.06	13.37
July	20.75	16.15	11.81	13.94	16.06	23.85	15.00	15.75	14.75	13.25	14.70	13.75	13.30
August	23.06	15.19	12.00	14.40	17.30	23.00	15.25	16.38	14.31	13.45	15.06	14.06	13.25
September	25.00	14.75	12.00	14.37	18.69	21.50	15.65	17.35	14.25	13.31	15.87	14.25	13.25
October	25.65	13.50	12.81	15.31	20.00	20.95	15.75	17.88	14.25	13.25	16.80	14.35	12.90
November	23.62	12.00	15.19	16.60	23.38	19.50	16.00	17.75	14.25	13.20	17.25	13.87	12.90
December	22.44	12.05	15.85	16.75	25.00	17.00	16.25	17.45	14.25	13.19	17.25	13.95	12.50

Local No. 2 Foundry Pig Iron at Chicago (at Furnace after 1907), per Gross Ton

	1888	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
January	$19.00	$16.00	$19.50	$14.60	$14.50	$13.37	$12.50	$9.75	$13.55	$11.02	$11.35	$11.47	$23.85	$15.10
February	18.87	15.00	18.87	15.00	14.37	12.81	11.87	9.75	12.50	11.00	11.28	12.47	23.85	14.60
March	18.12	15.00	17.62	15.00	14.00	13.00	11.30	9.81	12.00	10.88	11.10	14.95	23.85	15.60
April	17.50	15.00	16.62	15.12	14.00	13.00	10.50	10.25	12.00	10.75	11.26	15.47	23.72	15.85
May	17.00	15.00	16.20	15.00	14.00	12.96	10.50	10.25	11.69	10.38	11.35	15.72	22.65	15.85
June	16.25	14.50	16.00	15.00	14.00	13.00	10.50	10.88	11.50	10.25	11.35	17.95	20.72	15.35
July	16.00	14.87	16.00	15.15	14.00	12.79	10.12	12.13	11.25	10.25	11.35	19.22	18.60	15.35
August	16.00	15.10	16.00	15.00	13.75	12.75	10.00	13.20	11.18	10.25	11.35	20.65	16.25	15.35
September	16.50	15.50	16.00	15.00	13.50	12.75	10.00	13.63	10.75	10.40	11.35	22.22	15.35	15.35
October	17.12	17.00	16.00	15.00	13.50	12.75	10.00	14.00	10.88	11.00	11.35	23.35	14.85	15.10
November	17.00	17.62	15.75	14.94	13.50	12.75	9.70	14.00	11.19	11.00	11.35	23.45	14.85	15.23
December	16.87	18.66	15.37	14.62	13.50	11.69	9.75	14.00	11.25	11.00	11.35	23.85	15.10	15.85

	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	$16.25	$23.45	$14.47	$17.85	$19.60	$25.85	$18.45	$17.35	$19.00	$15.50	$14.00	$17.90	$13.80
February	16.85	23.35	13.91	17.85	19.41	25.85	18.16	16.75	19.00	15.50	14.00	17.31	14.00
March	18.51	23.22	14.05	17.80	19.35	26.10	17.85	16.50	18.30	15.50	14.00	17.25	14.25
April	18.97	22.87	14.35	17.60	19.10	26.35	17.73	16.50	17.50	15.00	14.00	17.06	14.25
May	20.85	20.72	13.85	17.60	18.90	26.85	17.63	16.50	17.06	15.00	14.50	16.15	14.06
June	21.85	19.85	13.70	17.00	18.54	26.60	17.73	16.50	16.75	15.00	14.50	15.63	13.69
July	21.60	18.25	13.60	16.47	18.60	25.55	17.55	17.00	16.56	14.87	14.70	14.70	13.75
August	22.10	17.22	13.60	16.60	19.45	24.85	17.35	17.13	16.50	14.50	15.37	15.00	13.69
September	23.35	16.41	13.85	16.60	20.16	24.10	17.05	18.70	16.40	14.50	16.00	15.00	13.31
October	23.35	15.70	14.10	17.66	21.48	22.45	16.85	19.00	16.06	14.46	17.00	15.00	12.94
November	23.35	15.10	15.98	19.15	24.70	20.66	17.10	19.00	16.00	14.09	17.75	14.88	12.56
December	23.35	14.81	16.95	19.60	25.85	18.80	17.35	19.00	16.00	14.00	18.00	14.50	12.90

The Cincinnati prices given above date back to the earliest period for which Southern pig-iron quotations are available at that point. It may be said that these quotations represent almost the beginning of the Northern business in pig iron coming from the vicinity of Birmingham, Ala.

The Chicago prices also represent quotations from the beginning of the production of pig iron in the vicinity of Chicago for the merchant trade. For a long time these prices were quoted delivered on track near Chicago foundries, but beginning in 1908 prices were figured at the furnace, from which at that time a switching charge to local foundries of about 35 cents per ton applied. At the present time the switching charge averages about 50 cents.

The electrification of the Puget Sound lines of the Chicago, Milwaukee & St. Paul Railroad is the most important steam road electrification ever undertaken. The initial work includes the electrification of one complete engine division 113 miles in length and the total, including yards, sidings, etc., amounts to 168 miles. This work is already under way and in the early future, if the initial work proves successful, three additional engine divisions will be electrified, making approximately 440 miles of main line track or a total of 650 miles.

The Bearings Company of America is announced as successor to the Star Ball Retainer Company, which was dissolved December 31. All factory correspondence is to be addressed to the Bearings Company of America, Star Ball Retainer Department, Lancaster, Pa. All correspondence relating to sales is to be addressed to the Bearings Company of America, Sales Department, 250 West Fifty-fourth street, New York. The efficient direction is to be continued. The Bearings Company of America has also succeeded the J. S. Bretz Company, New York, and Fichtel & Sachs, Lancaster, Pa.

Connellsville Coke Prices for Fifteen Years

We present below tables showing monthly prices of prompt shipment Connellsville furnace and foundry coke for 15 years, 1900 to 1914, inclusive, averaged from weekly quotations in *The Iron Age.*

Average Prices of Prompt Connellsville Furnace Coke, per Net Ton at Oven

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	$3.37½	$1.75	$2.90	$5.00	$1.60	$2.46	$2.62½	$3.53	$1.92	$1.59	$2.55	$1.40	$1.82	$3.88	$1.85
Feb.	3.00	1.75	2.50	5.00	1.52½	2.56	2.14	3.50	1.86	1.59	2.12½	1.45	1.78	2.52	1.85
Mar.	3.55	1.90	2.87½	5.00	1.65	2.43	2.24	3.02	1.72½	1.60	2.00	1.55	2.12½	2.40	1.90
Apr.	3.56	2.00	2.50	4.20	1.60	2.07½	2.45	2.72½	1.57	1.60	1.77½	1.59	2.39	2.15	1.86
May	3.00	2.00	2.50	3.50	1.50	1.87½	2.46	2.16	1.50	1.57½	1.66	1.50	2.28	2.13	1.77
June	2.75	1.87½	2.69	3.00	1.45	1.82	2.32½	1.89	1.55	1.52½	1.65	1.42	2.02	2.11	1.75
July	2.37½	1.75	3.00	2.50	1.45	1.81	2.51	2.40	1.57½	1.58	1.59	1.44	2.21	2.45	1.75
Aug.	2.00	1.75	3.87½	2.25	1.45	1.80	2.76	2.62	1.50	1.66	1.57	1.46	2.21	2.50	1.70
Sept.	2.00	1.75	5.00	2.20	1.45	2.10	2.85	2.82½	1.50	2.39	1.60	1.50	2.37½	2.29	1.65
Oct.	2.00	1.77	8.00	1.90	1.47½	2.61	2.84	2.85	1.53	2.76	1.59	1.50	3.41	2.08	1.60
Nov.	2.00	1.95	6.00	1.75	2.04	2.95	3.13	2.41	1.72½	2.74	1.50	1.52	3.94	1.82	1.52
Dec.	1.87½	2.14	6.00	1.62½	2.12½	2.79	3.52½	2.06	1.82	2.67	1.44	1.60	4.00	1.75	1.50

Average Prices of Prompt Connellsville Foundry Coke, per Net Ton at Oven

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	$3.50	$2.25	$3.17	$6.50	$2.18	$2.38	$3.42	$4.25	$2.45	$2.00	$2.90	$1.90	$1.97½	$4.40	$2.50
Feb.	3.31	2.31	3.50	6.50	2.10	2.68	2.65	4.00	2.39	1.95	2.70	2.10	2.09	3.25	2.50
Mar.	4.10	2.50	3.50	6.50	2.25	2.75	2.78	3.65	2.25	1.95	2.60	2.05	2.56	3.00	2.45
Apr.	3.75	2.50	3.12½	5.50	2.15	2.70	2.95	3.31	2.22	1.86	2.45	2.00	2.69	3.00	2.40
May	3.15	2.50	3.15	4.50	2.00	2.55	2.81	3.00	2.03	1.85	2.20	1.81	2.58	2.85	2.40
June	3.06	2.37½	2.87½	3.50	1.90	2.40	2.65	3.00	2.00	1.80	2.17	1.76	2.40	2.80	2.32
July	2.81	2.25	3.20	3.25	1.80	2.35	2.79	3.00	2.00	2.00	2.15	1.82½	2.40	2.70	2.22
Aug.	2.70	2.25	4.25	3.00	1.75	2.25	3.00	3.08	1.92	1.95	2.15	1.85	2.40	2.90	2.25
Sept.	2.31	2.25	6.00	2.87½	1.85	2.50	3.19	3.20	1.90	2.55	2.12	1.85	2.54	2.90	2.10
Oct.	2.25	2.25	9.00	2.87½	2.00	3.00	3.31	3.25	2.10	2.90	2.10	1.81	3.65	2.81	2.00
Nov.	2.25	2.31	7.00	2.50	2.25	3.50	4.00	2.75	2.20	3.25	2.05	1.85	4.25	2.60	1.92
Dec.	2.25	2.39	7.00	2.25	2.35	3.50	4.12½	2.50	2.25	3.20	1.97	1.90	4.50	2.50	1.90

Attention should be called to the peculiar conditions prevailing in the coke market in the last half of 1902 and the first half of 1903. In all this period coke prices were seriously affected by the extraordinary demand for coke caused by the scarcity of anthracite coal resulting from the great strike of anthracite coal miners which began in the spring of 1902 and was not settled until late in that year. For several months blast furnaces and foundries were greatly hampered in their operations by inability to secure a regular supply of fuel. Prompt furnace and foundry coke at this time sold as high as $11 per ton at oven, and it is possible that even higher prices may have been realized. Blast furnaces were often banked for a week or two awaiting coke deliveries, and many foundries ran intermittently. Coke was imported to some extent for the use of blast furnaces and foundries located near the seaboard, and foundry coke was shipped all the way to Chicago from Colorado. The quotations which are above given for this period are therefore to be regarded as to some extent conjectural.

Malleable Bessemer Pig-Iron Prices, Chicago

The table below shows monthly prices of malleable Bessemer pig iron at Chicago from 1900 to 1914, inclusive, averaged from weekly quotations in *The Iron Age,* per ton of 2240 lb.

	1900	1901	1902	1903	1904	1905	1906	1907	1908*	1909	1910	1911	1912	1913	1914
Jan.	$25.00	$15.00	$17.20	$23.24	$14.50	$17.50	$19.37	$26.00	$18.60	$17.09	$19.00	$15.50	$14.35	$17.90	$13.88
Feb.	25.00	14.87	17.75	23.00	14.50	17.50	19.19	26.00	18.25	16.75	19.00	15.50	14.14	17.31	13.94
Mar.	25.00	15.75	18.50	22.87	14.00	17.50	19.00	26.25	17.50	16.50	18.40	15.50	14.00	17.25	14.25
Apr.	24.25	16.50	19.50	21.82	14.00	17.50	18.77	26.50	17.50	16.50	17.50	15.25	14.00	17.05	14.25
May	23.40	15.45	21.80	20.77	14.00	17.37	18.35	26.60	17.56	16.66	17.06	15.00	14.40	16.00	14.06
June	21.12	16.25	22.00	19.50	13.85	16.65	18.00	26.25	17.37	16.50	16.75	15.00	14.50	15.62	13.88
July	19.50	16.25	22.75	18.66	13.75	16.37	18.37	25.62	17.50	16.90	16.56	15.00	14.50	14.65	14.00
Aug.	17.50	16.30	23.00	17.59	13.75	16.50	18.95	24.80	17.50	17.12	16.50	14.80	15.10	15.00	14.00
Sept.	16.12	16.00	24.00	16.94	13.50	16.56	20.12	24.40	17.26	18.50	16.40	14.50	16.25	15.00	13.25
Oct.	14.81	15.75	23.90	16.25	13.75	17.37	21.32	22.40	17.00	18.50	16.06	14.50	17.10	15.20	13.00
Nov.	14.62	15.81	23.87	15.00	15.87	19.00	24.16	20.25	17.00	19.00	16.00	14.35	17.87	14.87	12.88
Dec.	15.00	17.00	24.00	14.50	16.50	19.50	26.00	18.75	17.00	19.00	16.00	14.35	18.00	14.63	12.90

*From this time on the prices are given as at furnace near Chicago, and 35c. to 50c. per ton should be added to get the price delivered to Chicago foundries.

Mahoning and Shenango Foundry Iron Prices

In the following table are presented the monthly average prices of No. 2 foundry pig iron at Valley furnace, namely, at furnaces in the Mahoning Valley, Ohio, and the Shenango Valley, Pennsylvania, from 1900 to 1914, inclusive, averaged from weekly quotations in *The Iron Age:*

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	$21.50	$13.20	$15.60	$22.30	$13.00	$16.12	$17.31	$24.60	$16.80	$15.44	$17.00	$13.75	$13.00	$17.50	$12.85
Feb.	22.04	13.16	16.20	21.95	12.47	16.00	17.25	24.12	16.00	15.06	16.69	13.75	13.00	17.00	13.19
Mar.	22.10	13.97	17.76	22.00	12.91	16.00	17.12	24.00	15.56	14.50	16.10	13.75	13.12	16.69	13.25
Apr.	21.26	14.10	19.30	20.99	13.01	16.00	16.50	24.00	15.15	14.00	15.62	13.75	13.25	15.55	13.25
May	20.30	14.10	19.92	20.32	12.47	15.55	16.30	25.00	14.87	14.19	15.31	13.75	13.25	14.62	13.00
June	17.91	13.66	20.60	19.37	11.96	14.81	16.19	25.12	15.00	14.90	14.75	13.56	13.25	14.06	13.00
July	16.29	13.20	21.10	18.02	11.67	14.25	16.44	22.80	14.80	15.19	14.31	13.50	13.37	13.87	13.00
Aug.	14.42	12.97	22.35	16.34	11.87	14.15	17.71	22.50	14.50	15.31	14.15	13.50	13.69	14.00	13.00
Sept.	13.16	13.10	22.30	14.98	11.71	14.56	19.56	20.87	14.47	15.75	13.75	13.44	14.44	14.00	13.00
Oct.	12.85	13.60	22.17	14.09	12.50	15.50	21.35	19.80	14.36	17.12	13.94	13.37	16.10	13.84	12.90
Nov.	13.35	14.41	23.25	13.32	14.60	16.83	23.87	19.00	15.25	17.25	13.90	13.20	16.94	13.50	12.75
Dec.	13.04	15.20	21.25	13.22	16.19	17.35	24.00	17.37	15.50	17.00	13.75	13.00	17.25	13.50	12.75

Scrap Prices at Chicago, 1903 to 1914

These prices are averaged from weekly quotations in *The Iron Age*.

Heavy Melting Steel Scrap, per Gross Ton

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	$18.05	$10.13	$14.88	$14.95	$16.80	$11.05	$13.94	$16.00	$11.75	$10.75	$12.60	$9.35
February	18.13	10.88	14.13	13.63	15.75	12.50	13.56	15.50	12.06	10.75	12.13	10.50
March	18.31	11.50	14.45	13.00	16.00	11.44	12.13	15.00	12.15	10.94	12.08	9.81
April	18.35	11.25	14.38	13.50	15.75	11.05	12.35	14.44	11.75	11.56	12.50	9.80
May	17.63	9.75	12.55	13.70	15.60	10.62	13.44	13.56	10.50	12.05	11.25	9.69
June	16.50	9.30	11.95	13.13	16.25	11.62	14.50	13.15	10.38	12.12	10.44	9.75
July	16.30	9.00	12.75	13.13	16.12	11.75	14.06	12.38	10.69	11.69	10.50	9.75
August	16.00	9.25	13.15	14.10	15.10	12.88	15.00	12.25	11.05	12.25	10.56	9.69
September	13.75	10.00	14.38	16.50	14.75	13.00	16.00	12.25	10.70	12.81	10.06	9.19
October	12.80	10.88	14.50	16.60	14.70	13.45	16.43	12.25	10.00	13.35	10.00	8.50
November	11.25	12.55	15.20	17.50	12.63	14.88	16.00	12.25	9.75	13.69	9.56	8.06
December	9.00	14.15	15.25	17.13	11.50	15.17	16.00	12.10	10.25	12.88	9.00	8.43

Old Steel Rerolling Rails, per Gross Ton

January	$23.50	$11.75	$16.00	$16.50	$19.00	$12.30	$15.81	$18.00	$13.69	$13.00	$16.15	$11.10
February	23.50	13.13	15.13	16.25	19.00	13.00	15.12	18.00	13.63	12.80	15.50	11.81
March	22.13	13.00	15.30	15.70	19.00	12.19	13.06	17.80	13.65	12.75	15.00	11.56
April	22.00	13.00	15.44	15.75	18.50	12.60	13.20	17.69	13.44	12.88	14.63	11.50
May	22.13	11.88	14.06	16.00	18.60	12.94	14.44	17.12	13.49	13.50	13.95	11.31
June	21.00	10.80	12.95	15.88	18.94	13.94	15.50	16.50	12.38	13.50	12.69	11.50
July	19.00	10.31	13.56	15.50	18.00	14.50	15.40	15.88	12.25	13.50	12.25	11.50
August	19.00	11.50	14.35	15.90	17.00	15.63	16.12	15.31	12.65	14.00	12.12	11.50
September	17.33	11.81	15.25	17.63	16.75	16.18	17.15	15.25	12.75	15.00	12.25	10.75
October	15.40	12.38	15.63	18.63	17.15	15.80	18.00	15.25	12.44	16.30	12.15	10.00
November	13.50	14.75	16.30	21.15	15.06	17.19	18.00	15.06	12.30	16.50	12.00	9.50
December	10.60	16.00	16.50	21.00	12.94	16.95	18.00	14.20	12.50	16.50	11.33	9.50

Old Iron Rails, per Gross Ton

January	$24.00	$14.00	$21.13	$23.00	$27.40	$15.60	$18.81	$20.00	$15.00	$15.19	$17.05	$13.00
February	24.00	16.50	20.00	21.75	25.50	17.12	18.25	19.25	15.25	15.25	16.25	13.13
March	24.00	16.60	19.60	20.75	25.00	15.44	16.94	19.00	15.35	15.31	16.25	12.94
April	23.75	16.88	19.75	20.88	24.88	15.00	16.10	18.50	14.69	15.56	16.19	12.75
May	23.75	15.88	18.50	21.25	24.50	14.81	16.63	17.62	14.69	16.25	15.90	12.75
June	21.00	14.65	17.15	21.25	24.50	15.50	17.00	17.00	14.38	16.25	14.75	12.75
July	19.70	14.13	17.81	21.25	23.75	15.90	17.00	16.75	14.25	16.25	14.00	12.15
August	18.50	15.32	19.35	21.90	20.65	16.56	18.38	16.25	14.25	16.30	14.00	12.00
September	17.75	16.00	20.88	23.50	20.25	17.35	19.20	16.00	14.50	16.88	14.00	11.70
October	17.00	16.69	22.13	26.00	20.05	18.00	20.75	16.00	13.88	17.95	13.90	11.13
November	16.25	20.13	22.90	28.00	17.63	18.38	20.62	16.00	14.75	18.25	13.50	11.00
December	13.00	22.00	23.00	28.00	15.50	19.50	20.00	15.70	15.00	17.68	13.16	11.00

No. 1 Railroad Wrought, per Net Ton

January	$19.50	$10.85	$18.19	$17.30	$16.35	$11.20	$13.81	$14.88	$11.75	$11.63	$12.70	$8.70
February	19.50	12.50	17.00	15.88	15.50	12.44	12.88	14.69	12.00	11.30	12.19	9.50
March	19.75	12.80	16.40	14.88	15.25	11.25	11.43	14.45	12.30	11.44	12.13	9.06
April	20.40	12.50	16.06	14.50	15.25	11.00	11.90	14.19	11.69	12.31	12.38	9.00
May	19.13	11.38	14.19	14.50	15.45	10.75	12.81	12.87	11.38	12.75	11.25	9.00
June	16.13	10.50	13.50	13.50	16.06	11.69	13.38	12.75	11.25	12.57	10.56	9.00
July	14.65	10.44	14.13	13.50	15.06	12.15	13.16	12.44	11.00	12.06	10.55	9.00
August	14.19	11.13	15.45	14.50	14.40	12.69	14.44	11.94	11.10	12.50	10.62	8.94
September	14.06	11.85	16.31	16.13	14.38	13.44	15.35	11.94	10.94	13.13	10.19	8.37
October	13.55	12.50	17.00	17.50	14.60	13.60	15.94	11.75	10.44	14.25	9.60	7.87
November	12.00	15.44	17.50	18.00	12.32	14.38	15.31	11.94	10.20	13.50	9.00	7.56
December	10.00	17.55	18.00	17.25	11.00	14.83	14.75	11.65	10.75	13.06	8.50	7.90

Heavy Cast Scrap, per Net Ton

January	$17.30	$10.50	$13.81	$14.70	$17.80	$12.95	$13.06	$14.88	$12.19	$11.25	$12.90	$10.20
February	16.63	11.38	13.13	13.50	18.25	13.00	12.75	14.88	12.13	11.25	12.69	10.87
March	18.13	12.00	13.40	12.75	19.50	12.12	12.19	14.50	12.25	11.31	12.50	10.37
April	17.80	11.13	13.81	12.94	18.88	12.05	12.60	13.69	11.81	12.06	12.44	10.25
May	16.75	10.25	12.50	13.40	18.55	11.50	13.31	13.13	11.00	12.20	11.60	10.06
June	14.63	8.80	12.40	13.50	18.94	12.00	13.81	13.00	10.75	11.81	10.63	9.75
July	14.20	8.94	13.38	13.50	18.44	12.15	13.44	13.00	10.50	11.75	10.70	9.65
August	14.00	9.88	13.20	14.00	16.75	12.75	14.06	12.75	10.55	12.15	10.87	9.50
September	13.00	10.70	13.38	15.38	16.81	12.88	14.75	12.75	10.10	12.81	10.62	9.19
October	12.40	10.05	13.63	15.90	16.25	13.25	15.63	12.50	10.25	14.20	10.40	9.00
November	11.63	12.69	14.30	17.50	14.00	13.75	15.12	12.50	10.35	13.50	10.06	8.56
December	10.50	14.15	15.00	17.50	13.00	13.92	14.75	12.30	11.00	13.25	9.83	9.00

Railroad Malleable Scrap, per Net Ton

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	$16.25	$8.25	$14.06	$15.00	$17.20	$10.40	$12.88	$15.00	$10.94	$10.88	$13.40	$9.25
February	16.25	9.50	13.69	14.25	16.00	11.31	12.38	14.69	10.50	10.30	13.00	10.38
March	16.25	10.00	13.44	13.00	16.25	10.00	11.50	14.50	11.00	10.44	13.00	9.56
April	16.45	10.00	13.25	13.38	16.38	10.10	11.25	13.69	11.00	11.19	13.19	9.15
May	15.88	9.38	12.38	13.50	16.25	9.81	12.38	12.94	10.38	11.55	12.10	9.13
June	15.00	8.20	11.90	13.50	17.50	10.25	12.94	12.20	10.10	11.75	11.06	9.00
July	15.00	8.25	12.31	13.38	16.75	11.40	12.75	11.25	10.00	11.75	10.60	9.00
August	14.50	8.44	13.15	13.60	16.00	12.06	13.69	11.00	10.05	12.05	10.38	8.88
September	13.75	9.20	14.19	15.00	16.00	12.38	15.15	11.20	10.00	12.56	10.19	8.25
October	13.30	9.88	14.25	15.13	15.20	12.45	15.25	11.00	9.69	13.75	9.65	7.90
November	10.25	11.80	14.55	17.30	12.25	13.44	15.13	11.25	9.50	13.56	9.31	7.75
December	8.70	13.56	15.00	18.00	10.50	13.70	14.95	11.25	10.06	13.50	9.00	7.95

Frogs, Switches and Guards, Cut Apart, Per Gross Ton

	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	....	$14.88	$15.00	$17.40	$11.40	$14.00	$16.00	$11.50	$10.50	$12.65	$9.30
February	....	14.06	14.75	16.25	12.38	13.56	15.50	11.88	10.50	12.13	10.50
March	....	14.50	13.70	16.50	11.69	12.50	15.00	12.10	10.88	12.13	9.81
April	....	14.25	13.50	16.50	11.50	12.55	14.50	11.63	11.38	12.44	9.90
May	....	13.31	13.70	16.90	11.56	13.44	13.69	10.38	11.80	11.30	9.69
June	....	12.10	13.13	17.25	11.63	14.50	13.15	10.20	11.88	10.44	9.69
July	....	12.75	13.25	16.81	12.30	14.15	12.38	10.44	11.56	10.50	9.75
August	....	13.15	14.30	15.50	14.00	14.88	12.25	10.70	11.95	10.56	9.69
September	....	14.38	16.63	15.50	13.63	15.95	12.25	10.38	12.63	10.19	9.19
October	....	14.50	17.13	15.30	13.85	16.63	12.25	9.94	13.75	10.00	8.75
November	$13.25	15.40	18.30	12.69	14.50	16.06	12.25	9.65	13.44	9.56	8.19
December	14.38	15.50	18.00	11.63	14.95	16.00	12.10	10.13	12.63	9.00	8.40

Old Carwheels, Per Gross Ton

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	$24.00	$13.26	$16.56	$19.00	$24.90	$20.10	$15.75	$18.38	$13.00	$13.25	$16.95	$11.65
February	24.00	14.13	16.38	19.00	23.50	16.94	15.25	17.88	13.00	13.05	16.75	12.44
March	24.00	14.50	15.75	18.60	23.88	15.50	14.69	17.00	13.25	13.00	16.75	11.88
April	24.00	14.00	15.88	18.75	25.00	14.00	14.50	16.50	13.25	13.25	16.75	11.55
May	22.88	13.13	14.81	19.00	25.20	12.88	14.81	15.75	12.75	13.90	15.05	11.50
June	21.75	11.20	14.25	18.00	25.38	13.00	15.81	15.50	12.55	14.13	13.94	11.50
July	21.50	10.63	14.38	18.00	24.25	13.30	16.00	14.81	12.50	13.88	12.90	11.25
August	21.38	11.13	14.95	18.50	24.50	15.50	16.25	14.50	12.85	13.70	12.75	11.25
September	20.25	11.10	15.75	19.75	24.50	15.50	18.05	14.00	12.81	14.38	12.63	11.06
October	18.00	12.00	16.00	19.31	24.38	15.25	18.31	14.00	12.50	16.00	12.10	10.65
November	15.75	14.25	17.10	22.60	23.13	15.50	18.50	13.50	12.10	16.69	12.00	9.81
December	13.00	16.25	18.75	25.00	22.00	16.00	18.50	13.50	13.06	16.75	11.88	9.60

Connellsville Coke Prices for Fifteen Years

We present below tables showing monthly prices of prompt shipment Connellsville furnace and foundry coke for 15 years, 1900 to 1914, inclusive, averaged from weekly quotations in *The Iron Age.*

Average Prices of Prompt Connellsville Furnace Coke, per Net Ton at Oven

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	$3.37½	$1.75	$2.90	$5.00	$1.60	$2.46	$2.62½	$3.53	$1.92	$1.59	$2.55	$1.40	$1.82	$3.88	$1.85
Feb.	3.00	1.75	2.50	5.00	1.52½	2.56	2.14	3.50	1.86	1.59	2.12½	1.45	1.78	2.52	1.85
Mar.	3.55	1.90	2.87½	5.00	1.65	2.43	2.24	3.02	1.72½	1.60	2.00	1.55	2.12½	2.40	1.90
Apr.	3.56	2.00	2.50	4.20	1.60	2.07½	2.45	2.72½	1.57	1.60	1.77½	1.59	2.39	2.15	1.86
May	3.00	2.00	2.50	3.50	1.50	1.87½	2.46	2.16	1.50	1.57½	1.66	1.50	2.28	2.13	1.77
June	2.75	1.87½	2.69	3.00	1.45	1.82	2.32½	1.89	1.55	1.52½	1.65	1.42	2.02	2.11	1.75
July	2.37½	1.75	3.00	2.50	1.45	1.81	2.51	2.40	1.57½	1.58	1.59	1.44	2.21	2.45	1.75
Aug.	2.00	1.75	3.87½	2.25	1.45	1.80	2.76	2.62	1.50	1.66	1.57	1.46	2.21	2.50	1.70
Sept.	2.00	1.75	5.00	2.20	1.45	2.10	2.85	2.82½	1.50	2.39	1.60	1.50	2.37½	2.29	1.65
Oct.	2.00	1.77	8.00	1.90	1.47½	2.61	2.84	2.85	1.53	2.76	1.59	1.50	3.41	2.08	1.60
Nov.	2.00	1.95	6.00	1.75	2.04	2.95	3.13	2.41	1.72½	2.74	1.50	1.52	3.94	1.82	1.52
Dec.	1.87½	2.14	6.00	1.62½	2.12½	2.79	3.52½	2.06	1.82	2.67	1.44	1.60	4.00	1.75	1.50

Average Prices of Prompt Connellsville Foundry Coke, per Net Ton at Oven

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	$3.50	$2.25	$3.17	$6.50	$2.18	$2.38	$3.42	$4.25	$2.45	$2.00	$2.90	$1.90	$1.97½	$4.40	$2.50
Feb.	3.31	2.31	3.50	6.50	2.10	2.68	2.65	4.00	2.39	1.95	2.70	2.10	2.09	3.25	2.50
Mar.	4.10	2.50	3.50	6.50	2.25	2.75	2.78	3.65	2.25	1.95	2.60	2.05	2.56	3.00	2.45
Apr.	3.75	2.50	3.12½	5.50	2.15	2.70	2.95	3.31	2.22	1.86	2.45	2.00	2.69	3.00	2.40
May	3.15	2.50	3.15	4.50	2.00	2.55	2.81	3.00	2.03	1.85	2.20	1.81	2.58	2.85	2.40
June	3.06	2.37½	2.87½	3.50	1.90	2.40	2.65	3.00	2.00	1.80	2.17	1.76	2.40	2.80	2.32
July	2.81	2.25	3.20	3.25	1.80	2.35	2.79	3.00	2.00	2.00	2.15	1.82½	2.40	2.70	2.22
Aug.	2.70	2.25	4.25	3.00	1.75	2.25	3.00	3.08	1.92	1.95	2.15	1.85	2.40	2.90	2.25
Sept.	2.31	2.25	6.00	2.87½	1.85	2.50	3.19	3.20	1.90	2.55	2.12	1.85	2.54	2.90	2.10
Oct.	2.25	2.25	9.00	2.87½	2.00	3.00	3.31	3.25	2.10	2.90	2.10	1.81	3.65	2.81	2.00
Nov.	2.25	2.31	7.00	2.50	2.25	3.50	4.00	2.75	2.20	3.25	2.05	1.85	4.25	2.60	1.92
Dec.	2.25	2.39	7.00	2.25	2.35	3.50	4.12½	2.50	2.25	3.20	1.97	1.90	4.50	2.50	1.90

Attention should be called to the peculiar conditions prevailing in the coke market in the last half of 1902 and the first half of 1903. In all this period coke prices were seriously affected by the extraordinary demand for coke caused by the scarcity of anthracite coal resulting from the great strike of anthracite coal miners which began in the spring of 1902 and was not settled until late in that year. For several months blast furnaces and foundries were greatly hampered in their operations by inability to secure a regular supply of fuel. Prompt furnace and foundry coke at this time sold as high as $11 per ton at oven, and it is possible that even higher prices may have been realized. Blast furnaces were often banked for a week or two awaiting coke deliveries, and many foundries ran intermittently. Coke was imported to some extent for the use of blast furnaces and foundries located near the seaboard, and foundry coke was shipped all the way to Chicago from Colorado. The quotations which are above given for this period are therefore to be regarded as to some extent conjectural.

Malleable Bessemer Pig-Iron Prices, Chicago

The table below shows monthly prices of malleable Bessemer pig iron at Chicago from 1900 to 1914, inclusive, averaged from weekly quotations in *The Iron Age,* per ton of 2240 lb.

	1900	1901	1902	1903	1904	1905	1906	1907	1908*	1909	1910	1911	1912	1913	1914
Jan.	$25.00	$15.00	$17.20	$23.24	$14.50	$17.50	$19.37	$26.00	$18.60	$17.09	$19.00	$15.50	$14.35	$17.90	$13.88
Feb.	25.00	14.87	17.75	23.00	14.50	17.50	19.19	26.00	18.25	16.75	19.00	15.50	14.14	17.31	13.94
Mar.	25.00	15.75	18.50	22.87	14.00	17.50	19.00	26.25	17.50	16.50	18.40	15.50	14.00	17.25	14.25
Apr.	24.25	16.50	19.50	21.82	14.00	17.50	18.77	26.50	17.50	16.50	17.50	15.25	14.00	17.05	14.25
May	23.40	15.45	21.80	20.77	14.00	17.37	18.35	26.60	17.56	16.66	17.06	15.00	14.40	16.00	14.06
June	21.12	16.25	22.00	19.50	13.85	16.65	18.00	26.25	17.37	16.50	16.75	15.00	14.50	15.62	13.88
July	19.50	16.25	22.75	18.66	13.75	16.37	18.37	25.62	17.50	16.90	16.56	15.00	14.50	14.65	14.00
Aug.	17.50	16.30	23.00	17.59	13.75	16.50	18.95	24.80	17.50	17.12	16.50	14.80	15.10	15.00	14.00
Sept.	16.12	16.00	24.00	16.94	13.50	16.56	20.12	24.40	17.26	18.50	16.40	14.50	16.25	15.00	13.25
Oct.	14.81	15.75	23.90	16.25	13.75	17.37	21.32	22.40	17.00	18.50	16.06	14.50	17.10	15.20	13.00
Nov.	14.62	15.81	23.87	15.00	15.87	19.00	24.16	20.25	17.00	19.00	16.00	14.35	17.87	14.87	12.88
Dec.	15.00	17.00	24.00	14.50	16.50	19.50	26.00	18.75	17.00	19.00	16.00	14.35	18.00	14.63	12.90

*From this time on the prices are given as at furnace near Chicago, and 35c. to 50c. per ton should be added to get the price delivered to Chicago foundries.

Mahoning and Shenango Foundry Iron Prices

In the following table are presented the monthly average prices of No. 2 foundry pig iron at Valley furnace, namely, at furnaces in the Mahoning Valley, Ohio, and the Shenango Valley, Pennsylvania, from 1900 to 1914, inclusive, averaged from weekly quotations in *The Iron Age:*

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	$21.50	$13.20	$15.60	$22.30	$13.00	$16.12	$17.31	$24.60	$16.80	$15.44	$17.00	$13.75	$13.00	$17.50	$12.85
Feb.	22.04	13.16	16.20	21.95	12.47	16.00	17.25	24.12	16.00	15.06	16.69	13.75	13.00	17.00	13.19
Mar.	22.10	13.97	17.76	22.00	12.91	16.00	17.12	24.00	15.56	14.50	16.10	13.75	13.12	16.69	13.25
Apr.	21.26	14.10	19.30	20.99	13.01	16.00	16.50	24.00	15.15	14.00	15.62	13.75	13.25	15.55	13.25
May	20.30	14.10	19.92	20.32	12.47	15.56	16.30	25.00	14.87	14.19	15.31	13.75	13.25	14.62	13.00
June	17.91	13.66	20.60	19.37	11.96	14.81	16.19	25.12	15.00	14.90	14.75	13.56	13.25	14.06	13.00
July	16.29	13.20	21.10	18.02	11.67	14.25	16.44	22.80	14.80	15.19	14.31	13.50	13.37	13.87	13.00
Aug.	14.42	12.97	22.35	16.34	11.87	14.15	17.71	22.50	14.50	15.31	14.15	13.50	13.69	14.00	13.00
Sept.	13.16	13.10	22.30	14.98	11.71	14.56	19.56	20.87	14.47	15.75	13.75	13.44	14.44	14.00	13.00
Oct.	12.85	13.60	22.17	14.09	12.50	15.50	21.35	19.80	14.36	17.12	13.94	13.37	16.10	13.84	12.90
Nov.	13.35	14.41	23.25	13.32	14.60	16.83	23.87	19.00	15.25	17.25	13.90	13.20	16.94	13.50	12.75
Dec.	13.04	15.20	21.25	13.22	16.19	17.35	24.00	17.37	15.50	17.00	13.75	13.00	17.25	13.50	12.75

Scrap Prices at Chicago, 1903 to 1914

These prices are averaged from weekly quotations in *The Iron Age.*

Heavy Melting Steel Scrap, per Gross Ton

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	$18.05	$10.13	$14.88	$14.95	$16.80	$11.05	$13.94	$16.00	$11.75	$10.75	$12.60	$9.35
February	18.13	10.88	14.13	13.63	15.75	12.50	13.56	15.50	12.06	10.75	12.13	10.50
March	18.31	11.50	14.45	13.00	16.00	11.44	12.13	15.00	12.15	10.94	12.08	9.81
April	18.35	11.25	14.38	13.50	15.75	11.05	12.35	14.44	11.75	11.56	12.50	9.80
May	17.63	9.75	12.55	13.70	15.60	10.62	13.44	13.56	10.50	12.05	11.25	9.69
June	16.50	9.30	11.95	13.13	16.25	11.62	14.50	13.15	10.38	12.12	10.44	9.75
July	16.30	9.00	12.75	13.13	16.12	11.75	14.06	12.38	10.69	11.69	10.50	9.75
August	16.00	9.25	13.15	14.10	15.10	12.88	15.00	12.25	11.05	12.25	10.56	9.69
September	13.75	10.00	14.38	16.50	14.75	13.00	16.00	12.25	10.70	12.81	10.06	9.19
October	12.80	10.88	14.50	16.60	14.70	13.45	16.43	12.25	10.00	13.95	10.00	8.50
November	11.25	12.55	15.20	17.50	12.63	14.88	16.00	12.25	9.75	13.69	9.56	8.06
December	9.00	14.15	15.25	17.13	11.50	15.17	16.00	12.10	10.25	12.88	9.00	8.43

Old Steel Rerolling Rails, per Gross Ton

January	$23.50	$11.75	$16.00	$16.50	$19.00	$12.30	$15.81	$18.00	$13.69	$13.00	$16.15	$11.10
February	23.50	13.13	15.13	16.25	19.00	13.00	15.12	18.00	13.63	12.80	15.50	11.81
March	22.13	13.00	15.30	15.70	19.00	12.19	13.06	17.80	13.65	12.75	15.00	11.56
April	22.00	13.00	15.44	15.75	18.50	12.60	13.20	17.69	13.44	12.88	14.63	11.50
May	22.13	11.88	14.06	16.00	18.60	12.94	14.44	17.12	13.49	13.50	13.95	11.31
June	21.00	10.80	12.95	15.88	18.94	13.94	15.50	16.50	12.38	13.50	12.69	11.50
July	19.00	10.31	13.56	15.50	18.00	14.50	15.40	15.88	12.25	13.50	12.25	11.50
August	19.00	11.50	14.35	15.90	17.00	15.63	16.12	15.31	12.65	14.00	12.12	11.50
September	17.33	11.81	15.25	17.63	16.75	16.18	17.15	15.25	12.75	15.00	12.25	10.15
October	15.40	12.38	15.63	18.63	17.15	15.80	18.00	15.25	12.44	16.30	12.15	10.00
November	13.50	14.75	16.30	21.15	15.06	17.19	18.00	15.06	12.30	16.50	12.00	9.50
December	10.60	16.00	16.50	21.00	12.94	16.95	18.00	14.20	12.50	16.50	11.33	9.50

Old Iron Rails, per Gross Ton

January	$24.00	$14.00	$21.13	$23.00	$27.40	$15.60	$18.81	$20.00	$15.00	$15.19	$17.05	$13.00
February	24.00	16.50	20.00	21.75	25.50	17.12	18.25	19.25	15.25	15.25	16.25	13.13
March	24.00	16.60	19.60	20.75	25.00	15.44	16.94	19.00	15.35	15.31	16.25	12.94
April	23.75	16.88	19.75	20.88	24.88	15.00	16.10	18.50	14.69	15.56	16.19	12.75
May	23.75	15.88	18.50	21.25	24.50	14.81	16.63	17.62	14.69	16.25	15.90	12.75
June	21.00	14.65	17.15	21.25	24.50	15.50	17.00	17.00	14.38	16.25	14.75	12.75
July	19.70	14.13	17.81	21.25	23.75	15.90	17.00	16.75	14.25	16.25	14.00	12.15
August	18.50	15.32	19.35	21.90	20.65	16.56	18.38	16.25	14.25	16.30	14.00	12.00
September	17.75	16.00	20.88	23.50	20.25	17.35	19.20	16.00	14.50	16.88	14.00	11.70
October	17.00	16.69	22.13	26.00	20.05	18.00	20.75	16.00	13.88	17.95	13.90	11.13
November	16.25	20.13	22.90	28.00	17.63	18.38	20.62	16.00	14.75	18.25	13.50	11.00
December	13.00	22.00	23.00	28.00	15.50	19.50	20.00	15.70	15.00	17.68	13.16	11.00

No. 1 Railroad Wrought, per Net Ton

January	$19.50	$10.85	$18.19	$17.30	$16.35	$11.20	$13.81	$14.88	$11.75	$11.63	$12.70	$8.70
February	19.50	12.50	17.00	15.88	15.50	12.44	12.88	14.69	12.00	11.30	12.19	9.50
March	19.75	12.80	16.40	14.88	15.25	11.25	11.43	14.45	12.30	11.44	12.13	9.06
April	20.40	12.50	16.06	14.50	15.25	11.00	11.90	14.19	11.69	12.31	12.38	9.00
May	19.13	11.38	14.19	14.50	15.45	10.75	12.81	12.87	11.38	12.75	11.25	9.00
June	16.13	10.50	13.50	13.50	16.06	11.69	13.38	12.75	11.25	12.57	10.56	9.00
July	14.65	10.44	14.13	13.50	15.06	12.15	13.16	12.44	11.00	12.06	10.55	9.00
August	14.19	11.13	15.45	14.50	14.40	12.69	14.44	11.94	11.10	12.50	10.62	8.94
September	14.06	11.85	16.31	16.13	14.38	13.44	15.35	11.94	10.94	13.13	10.19	8.37
October	13.55	12.50	17.00	17.50	14.60	13.60	15.94	11.75	10.44	14.25	9.60	7.87
November	12.00	15.44	17.50	18.00	12.32	14.38	15.31	11.94	10.20	13.50	9.00	7.56
December	10.00	17.55	18.00	17.25	11.00	14.83	14.75	11.65	10.75	13.06	8.50	7.90

Heavy Cast Scrap, per Net Ton

January	$17.30	$10.50	$13.81	$14.70	$17.80	$12.95	$13.06	$14.88	$12.19	$11.25	$12.90	$10.20
February	16.63	11.38	13.13	13.50	18.25	13.00	12.75	14.88	12.13	11.25	12.69	10.87
March	18.13	12.00	13.40	12.75	19.50	12.12	12.19	14.50	12.25	11.31	12.50	10.37
April	17.80	11.13	13.81	12.94	18.88	12.05	12.60	13.69	11.81	12.06	12.44	10.25
May	16.75	10.25	12.50	13.40	18.55	11.50	13.31	13.13	11.00	12.20	11.60	10.06
June	14.63	8.80	12.40	13.50	18.94	12.00	13.81	13.00	10.75	11.81	10.63	9.75
July	14.20	8.94	13.38	13.50	18.44	12.15	13.44	13.00	10.50	11.75	10.70	9.65
August	14.00	9.88	13.20	14.00	16.75	12.75	14.06	12.75	10.55	12.15	10.87	9.50
September	13.00	10.70	13.38	15.38	16.81	12.88	14.75	12.75	10.10	12.81	10.62	9.19
October	12.40	10.05	13.63	15.90	16.25	13.25	15.63	12.50	10.25	14.20	10.40	9.00
November	11.63	12.69	14.30	17.50	14.00	13.75	15.12	12.50	10.35	13.50	10.06	8.56
December	10.50	14.15	15.00	17.50	13.00	13.92	14.75	12.30	11.00	13.25	9.83	9.00

Railroad Malleable Scrap, per Net Ton

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	$16.25	$8.25	$14.06	$15.00	$17.20	$10.40	$12.88	$15.00	$10.94	$10.88	$13.40	$9.25
February	16.25	9.50	13.69	14.25	16.00	11.31	12.38	14.69	10.50	10.30	13.00	10.38
March	16.25	10.00	13.44	13.00	16.25	10.00	11.50	14.50	11.00	10.44	13.00	9.56
April	16.45	10.00	13.25	13.38	16.38	10.10	11.25	13.69	11.00	11.19	13.19	9.15
May	15.88	9.38	12.38	13.50	16.25	9.81	12.38	12.94	10.38	11.55	12.10	9.13
June	15.00	8.20	11.90	13.50	17.50	10.25	12.94	12.20	10.10	11.75	11.06	9.00
July	15.00	8.25	12.31	13.38	16.75	11.40	12.75	11.25	10.00	11.75	10.60	9.00
August	14.50	8.44	13.15	13.60	16.00	12.06	13.69	11.00	10.05	12.05	10.38	8.88
September	13.75	9.20	14.19	15.00	16.00	12.38	15.15	11.20	10.00	12.56	10.19	8.25
October	13.30	9.88	14.25	15.13	15.20	12.45	15.25	11.00	9.69	13.75	9.65	7.90
November	10.25	11.80	14.55	17.30	12.25	13.44	15.13	11.25	9.50	13.56	9.31	7.75
December	8.70	13.56	15.00	18.00	10.50	13.70	14.95	11.25	10.06	13.50	9.00	7.95

Frogs, Switches and Guards, Cut Apart, Per Gross Ton

	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	....	$14.88	$15.00	$17.40	$11.40	$14.00	$16.00	$11.50	$10.50	$12.65	$9.30
February	....	14.06	14.75	16.25	12.38	13.56	15.50	11.88	10.50	12.13	10.50
March	....	14.50	13.70	16.50	11.69	12.50	15.00	12.10	10.88	12.13	9.81
April	....	14.25	13.50	16.50	11.50	12.55	14.50	11.63	11.38	12.44	9.90
May	....	13.31	13.70	16.90	11.56	13.44	13.69	10.38	11.80	11.30	9.69
June	....	12.10	13.13	17.25	11.63	14.50	13.15	10.20	11.88	10.44	9.69
July	....	12.75	13.25	16.81	12.30	14.15	12.38	10.44	11.56	10.50	9.75
August	....	13.15	14.30	15.50	14.00	14.88	12.25	10.70	11.95	10.56	9.69
September	....	14.38	16.63	15.50	13.63	15.95	12.25	10.38	12.63	10.19	9.19
October	....	14.50	17.13	15.30	13.85	16.63	12.25	9.94	13.75	10.00	8.75
November	$13.25	15.40	18.30	12.69	14.50	16.06	12.25	9.65	13.44	9.56	8.19
December	14.38	15.50	18.00	11.63	14.95	16.00	12.10	10.13	12.63	9.00	8.40

Old Carwheels, Per Gross Ton

	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	$24.00	$13.26	$16.56	$19.00	$24.90	$20.10	$15.75	$18.38	$13.00	$13.25	$16.95	$11.65
February	24.00	14.13	16.38	19.00	23.50	16.94	15.25	17.88	13.00	13.05	16.75	12.44
March	24.00	14.50	15.75	18.60	23.88	15.50	14.69	17.00	13.25	13.00	16.75	11.88
April	24.00	14.00	15.88	18.75	25.00	14.00	14.50	16.50	13.25	13.25	16.75	11.55
May	22.88	13.13	14.81	19.00	25.20	12.88	14.81	15.75	12.75	13.90	15.05	11.50
June	21.75	11.20	14.25	18.00	25.38	13.00	15.81	15.50	12.55	14.13	13.94	11.50
July	21.50	10.63	14.38	18.00	24.25	13.30	16.00	14.81	12.50	13.88	12.90	11.25
August	21.38	11.13	14.95	18.50	24.50	15.50	16.25	14.50	12.85	13.70	12.75	11.25
September	20.25	11.10	15.75	19.75	24.50	15.50	18.05	14.00	12.81	14.38	12.63	11.06
October	18.00	12.00	16.00	19.31	24.38	15.25	18.31	14.00	12.50	16.00	12.10	10.65
November	15.75	14.25	17.10	22.60	23.13	15.50	18.50	13.50	12.10	16.69	12.00	9.81
December	13.00	16.25	18.75	25.00	22.00	16.00	18.50	13.50	13.06	16.75	11.88	9.60

Iron and Steel Prices for Seventeen Years

Monthly Averages Computed from the Weekly Market Quotations of "The Iron Age" in the Period 1898-1914

(With Supplement)

Accompanying this issue of *The Iron Age* is our annual chart, in which lines are plotted to indicate the course of prices for pig iron, Bessemer steel billets and some leading forms of finished iron and steel in the 17 years ending with 1914. The diagrams are based on monthly averages of prices quoted week by week in our market reports from the leading selling centers. The table below, which gives the monthly average prices on which the chart is based, includes also the average prices of No. 2 X foundry pig iron at Philadelphia, which have not been put in graphic form.

Bessemer Pig Iron at Pittsburgh, per Gross Ton (2240 lb.)

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	$9.87	$10.87	$24.99	$13.15	$16.70	$22.15	$13.91	$16.85	$18.35	$23.15	$19.00	$17.34	$19.90	$15.90	$15.05	$18.15	$14.96
Feb.	10.05	11.60	24.80	14.43	16.93	21.45	13.66	16.41	18.35	22.85	17.90	16.78	19.34	15.90	14.90	18.15	15.09
Mar.	10.39	14.59	24.72	16.31	17.37	21.85	14.25	16.35	18.28	22.85	17.86	16.25	18.60	15.90	15.09	18.15	15.09
Apr.	10.41	15.03	24.70	16.75	18.75	21.28	14.18	16.35	18.19	23.25	17.49	15.78	18.27	15.90	15.15	17.90	14.90
May	10.30	16.20	21.00	16.30	20.75	20.01	13.60	16.16	18.10	24.01	16.93	15.84	17.52	15.90	15.13	17.70	14.90
June	10.34	18.51	19.72	16.00	21.56	19.72	12.81	16.65	18.23	24.27	16.90	16.05	16.60	15.90	15.15	17.14	14.90
July	10.25	20.65	16.75	16.00	21.60	18.89	12.40	14.85	18.41	23.55	16.83	16.46	16.40	15.90	15.20	16.70	14.90
Aug.	10.35	21.75	15.60	15.75	21.62	18.35	12.81	15.20	19.00	22.90	16.23	17.03	16.09	15.90	15.46	16.52	14.90
Sept.	10.78	23.43	13.87	15.75	21.75	17.22	12.63	15.91	19.54	22.90	15.90	18.05	15.90	15.90	16.15	16.65	14.90
Oct.	10.36	24.18	13.06	15.89	21.75	16.05	13.10	16.54	20.35	22.60	15.71	19.53	15.90	15.44	17.80	16.60	14.84
Nov.	10.15	24.78	13.48	16.00	21.68	15.18	14.85	17.85	22.85	20.65	16.59	19.90	15.82	15.00	18.02	16.02	14.59
Dec.	10.58	24.90	13.43	16.31	21.75	14.40	16.65	18.35	23.75	19.34	17.40	19.90	15.90	15.03	18.15	15.77	14.70

Bessemer Steel Billets at Pittsburgh, per Gross Ton

Jan.	14.93	16.62	34.50	19.75	27.50	29.60	23.00	22.75	26.25	29.40	28.00	25.00	27.50	23.00	20.00	28.30	20.13
Feb.	15.06	18.00	34.87	20.31	29.37	29.87	23.00	23.50	26.50	29.50	28.00	25.00	27.50	23.00	20.00	28.50	21.00
Mar.	15.25	24.30	33.00	22.88	31.25	30.62	23.00	24.00	26.70	29.00	28.00	23.00	27.50	23.00	19.75	28.50	21.00
Apr.	15.06	25.37	32.00	24.00	31.50	30.25	23.00	24.00	27.00	30.12	28.00	23.00	26.75	23.00	20.00	28.50	20.80
May	14.85	26.75	28.90	24.00	32.20	30.37	23.00	23.50	26.40	30.30	28.00	23.00	26.12	22.60	20.80	27.37	20.00
June	14.65	30.10	27.25	24.38	32.37	28.87	23.00	22.00	26.63	29.62	25.75	23.00	25.30	21.00	20.87	26.50	19.50
July	14.50	33.12	21.00	24.00	31.75	27.60	23.00	22.00	27.25	30.00	25.00	23.50	25.00	21.00	21.50	26.60	19.00
Aug.	15.85	35.40	18.20	24.20	31.06	27.00	23.00	24.00	27.80	29.25	25.00	24.13	24.62	21.00	22.12	26.00	20.25
Sept.	16.00	38.87	16.93	24.88	29.50	27.00	20.00	25.00	28.00	29.37	25.00	25.00	24.40	20.75	23.62	24.87	21.00
Oct.	15.56	38.75	16.50	26.70	29.70	27.00	19.50	25.62	28.00	28.20	25.00	26.25	23.75	20.00	26.00	23.30	20.00
Nov.	15.06	36.50	18.95	27.00	28.50	24.00	20.25	26.00	28.88	28.00	25.00	27.13	23.30	19.50	27.00	21.00	19.25
Dec.	15.80	33.75	19.75	27.50	29.12	23.00	21.20	26.00	29.50	28.00	25.00	27.50	23.00	19.25	27.00	20.00	19.00

Basic Pig Iron, f.o.b. Mahoning or Shenango Valley Furnace, per Gross Ton

Jan.	....	....	....	....	....	....	....	15.46	17.06	21.90	16.90	15.50	16.87	13.25	12.35	16.41	12.50
Feb.	....	....	....	....	....	....	....	15.25	16.82	22.00	15.97	15.12	16.31	13.65	12.25	16.30	13.19
Mar.	....	....	....	....	....	....	....	15.55	16.85	21.50	15.62	14.94	16.00	13.75	12.81	16.11	13.00
Apr.	....	....	....	....	....	....	....	15.06	16.88	21.50	15.25	14.05	15.94	13.75	13.00	15.87	13.00
May	....	....	....	....	....	....	....	15.06	17.00	22.90	14.91	14.12	15.19	13.32	13.00	15.15	13.00
June	....	....	....	....	....	....	11.76	14.60	16.94	22.40	15.25	14.62	14.70	13.05	13.12	14.50	13.00
July	....	....	....	....	....	....	11.20	14.00	17.12	21.75	14.51	15.05	14.50	13.12	13.40	14.37	13.00
Aug.	....	....	....	....	....	....	11.69	14.32	17.70	21.25	14.69	15.25	14.12	13.00	13.94	14.06	13.00
Sept.	....	....	....	....	....	....	11.60	14.86	18.44	20.06	14.43	15.90	13.70	12.80	14.37	14.00	13.00
Oct.	....	....	....	....	....	....	12.19	15.25	19.55	19.50	14.04	16.94	13.15	12.52	15.98	13.90	12.81
Nov.	....	....	....	....	....	....	14.00	16.87	21.37	18.12	14.72	17.25	13.25	12.42	16.37	13.09	12.48
Dec.	....	....	....	....	....	....	15.70	16.75	21.50	17.50	15.60	17.05	13.40	12.25	16.50	12.71	12.50

Southern No. 2 Foundry Pig Iron at Cincinnati, per Gross Ton

Jan.	9.50	10.31	20.69	13.45	14.55	21.65	12.37	16.25	16.75	26.00	16.15	16.25	17.25	14.25	13.25	16.95	13.88
Feb.	9.25	11.69	20.50	13.12	14.75	21.50	12.12	16.25	16.75	26.00	15.75	16.13	17.06	14.25	13.31	16.69	13.81
Mar.	9.25	13.75	20.30	14.00	14.75	21.37	12.10	16.25	16.65	26.00	15.50	15.05	16.30	14.25	13.50	16.31	14.00
Apr.	9.25	14.50	20.19	14.50	16.87	20.15	12.50	16.25	16.63	25.06	15.20	14.25	15.37	14.25	13.75	15.65	13.75
May	9.37	14.56	19.75	13.85	18.35	18.87	12.25	15.81	16.75	24.25	14.75	14.50	15.00	13.95	14.15	14.94	13.75
June	9.30	16.00	18.75	13.37	20.19	17.75	11.80	14.65	16.44	24.10	15.25	14.70	14.85	13.44	14.25	14.06	13.63
July	9.25	17.56	16.81	13.00	20.75	16.15	11.81	13.94	16.06	23.85	15.00	15.75	14.75	13.25	14.70	13.75	13.30
Aug.	9.37	18.35	14.25	13.00	23.06	15.19	12.00	14.40	17.30	23.00	15.25	16.38	14.31	13.45	15.06	14.06	13.25
Sept.	9.55	19.94	13.62	13.06	25.00	14.75	12.00	14.37	18.69	21.50	15.65	17.35	14.25	13.31	15.87	14.25	13.25
Oct.	9.75	20.75	12.87	13.75	25.65	13.50	12.81	15.31	20.00	20.95	15.75	17.88	14.25	13.25	16.80	14.35	12.90
Nov.	9.75	20.75	12.95	14.00	23.62	12.00	15.19	16.60	23.38	19.50	16.00	17.75	14.25	13.20	17.25	13.87	12.90
Dec.	9.90	20.75	13.75	14.25	22.44	12.05	15.85	16.75	25.00	17.00	16.25	17.45	14.25	13.19	17.25	13.95	12.50

Local No. 2 Foundry Pig Iron at Chicago (at Furnace), per Gross Ton

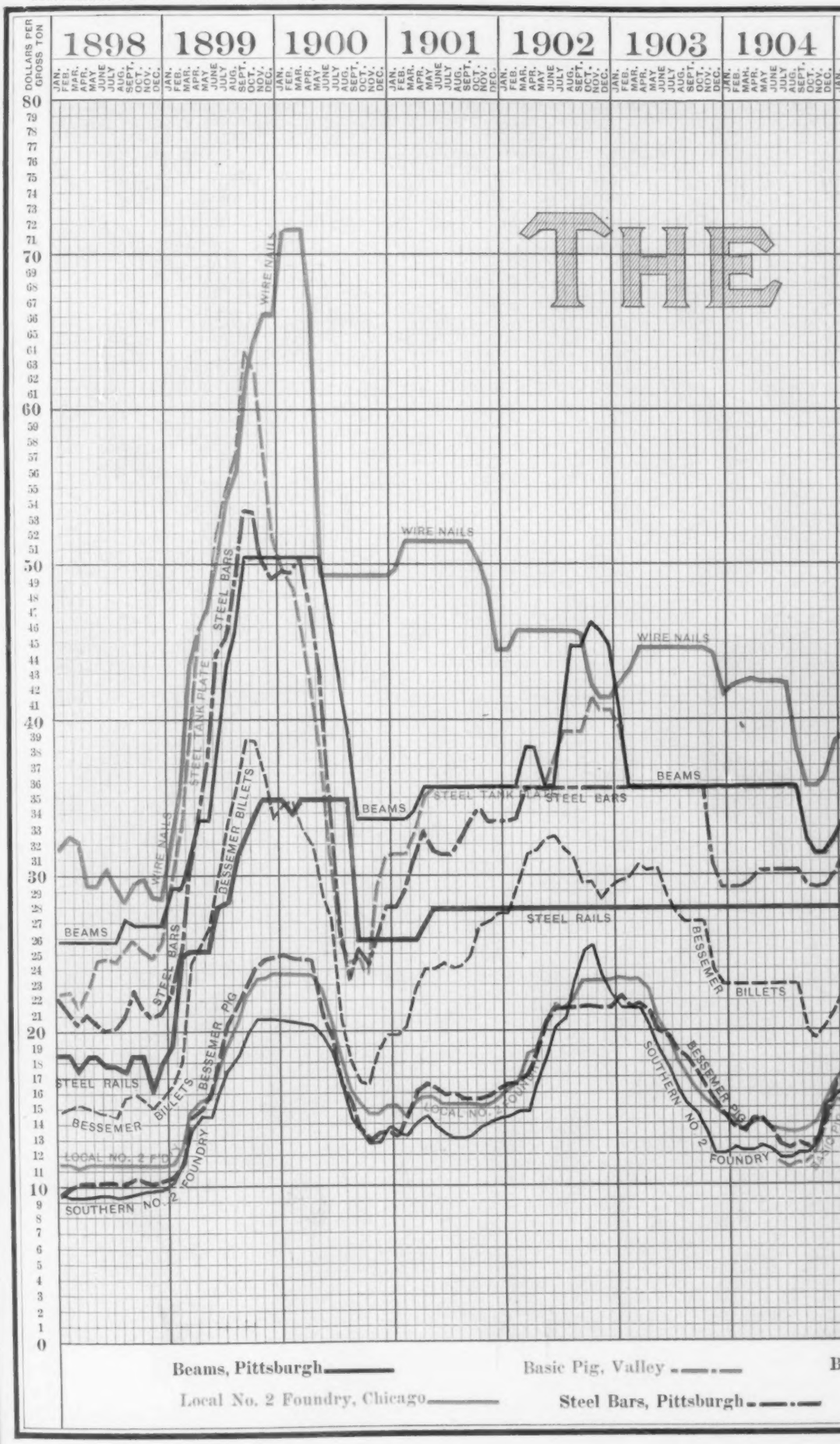
Jan.	11.35	11.47	23.85	15.10	16.25	23.45	14.47	17.85	19.60	25.85	18.45	17.35	19.00	15.50	14.00	17.90	13.75
Feb.	11.28	12.47	23.85	14.60	16.85	23.35	13.91	17.85	19.41	25.85	18.16	16.75	19.00	15.50	14.00	17.31	14.00
Mar.	11.10	14.95	23.85	15.60	18.51	23.22	14.05	17.80	19.35	26.10	17.85	16.50	18.30	15.50	14.00	17.25	14.25
Apr.	11.26	15.47	23.72	15.85	18.97	22.87	14.35	17.60	19.10	26.35	17.73	16.50	17.50	15.00	14.00	17.00	14.25
May	11.35	15.72	22.65	15.85	20.85	20.72	13.85	17.60	18.90	26.85	17.63	16.50	17.06	15.00	14.50	16.00	14.06
June	11.35	17.95	20.72	15.35	21.85	19.85	13.70	17.00	18.54	26.60	17.73	16.50	16.75	15.00	14.50	15.62	13.69
July	11.35	19.22	18.60	15.35	21.60	18.25	13.60	16.47	18.60	25.55	17.55	17.00	16.56	14.87	14.70	14.70	13.75
Aug.	11.35	20.65	16.25	15.35	22.10	17.22	13.60	16.60	19.45	24.85	17.35	17.13	16.50	14.50	15.37	15.00	13.69
Sept.	11.35	22.22	15.35	15.35	23.35	16.41	13.85	16.60	20.16	24.10	17.05	18.70	16.40	14.50	16.00	15.00	13.25
Oct.	11.35	23.35	14.85	15.10	23.35	15.70	14.10	17.66	21.48	22.45	16.85	19.00	16.06	14.46	17.00	15.00	12.94
Nov.	11.35	23.45	14.85	15.23	23.35	15.10	15.98	19.15	24.70	20.66	17.10	19.00	16.00	14.09	17.75	14.87	12.56
Dec.	11.35	23.85	15.10	15.85	23.35	14.81	16.95	19.60	25.85	18.80	17.35	19.00	16.00	14.00	18.00	14.60	13.00

Standard Brands Eastern Pennsylvania No. 2 X Foundry Pig Iron at Philadelphia per Gross Ton

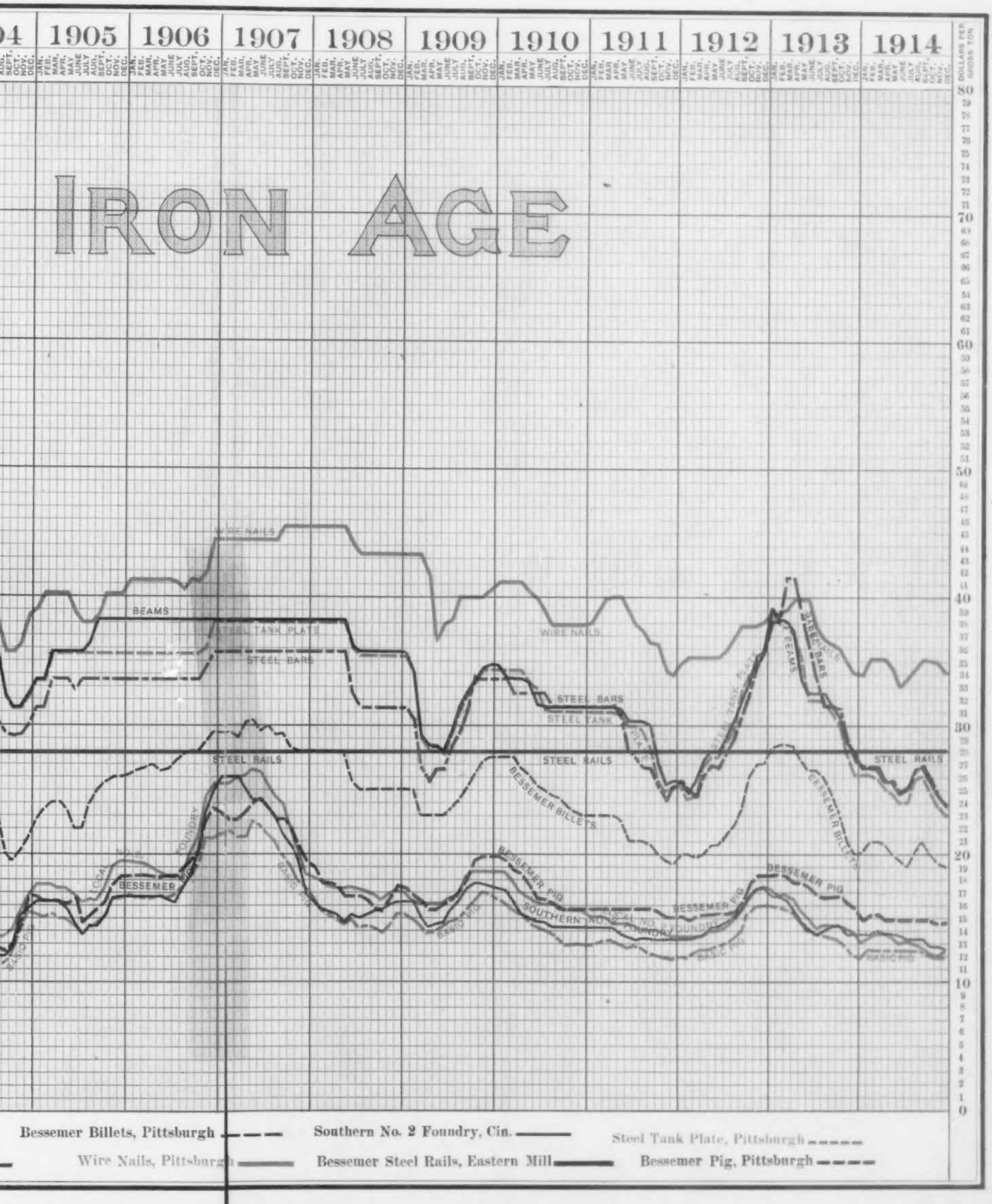
Jan.	10.87	11.44	22.70	15.50	16.75	22.45	14.69	17.50	18.50	24.80	18.25	17.25	19.00	15.50	14.85	18.25	14.65
Feb.	10.75	11.06	22.56	15.31	17.19	22.25	14.50	17.50	18.50	25.87	18.25	17.00	18.69	15.50	14.85	18.25	14.94
Mar.	10.55	14.70	22.31	15.12	18.81	22.25	14.80	17.56	18.35	25.00	18.12	16.37	18.00	15.50	14.92	17.77	15.00
Apr.	10.50	15.75	21.75	15.46	19.62	21.87	15.00	17.75	18.44	24.81	17.65	16.20	17.75	15.50	15.00	17.40	15.00
May	10.50	15.81	20.60	15.19	19.75	20.06	14.75	17.81	18.50	25.55	16.94	16.06	17.00	15.50	15.18	16.75	14.81
June	10.50	17.25	18.75	15.06	20.94	19.19	14.50	16.75	18.44	24.62	16.62	16.42	16.55	15.25	15.31	16.19	14.75
July	10.00	19.44	16.37	15.00	22.30	18.10	14.31	16.12	18.25	23.06	16.50	16.50	16.25	15.00	15.70	15.60	14.75
Aug.	10.30	20.65	16.15	14.97	22.00	16.87	14.25	16.25	19.00	21.90	16.50	17.00	16.00	15.00	15.87	15.60	14.75
Sept.	10.75	22.75	15.56	14.80	22.00	16.12	14.25	16.43	20.44	20.50	16.62	18.05	16.00	15.00	16.59	15.83	14.75
Oct.	10.75	22.75	15.00	15.25	22.12	15.20	14.43	17.25	21.12	19.85	16.75	18.69	15.81	15.00	17.60	15.95	14.63
Nov.	10.87	23.40	15.35	15.37	23.37	15.00	15.75	18.05	23.30	18.94	17.00	19.00	15.68	14.95	18.25	15.56	14.50
Dec.	11.06	23.25	15.62	15.75	23.00	15.00	16.90	18.25	24.00	18.84	17.25	19.00	15.50	14.85	18.25	15.30	14.25

Soft Steel Bars at Pittsburgh, in Cents per Pound

Jan.	0.99	1.02	2.22	1.25	1.50	1.60	1.30	1.40	1.50	1.60	1.60	1.40	1.50	1.40	1.15	1.70	1.20
Feb.	0.95	1.12	2.21	1.30	1.51	1.60	1.30	1.40	1.50	1.60	1.60	1.35	1.50	1.40	1.12	1.70	1.20
Mar.	0.93	1.36	2.25	1.40	1.60	1.60	1.33	1.50	1.50	1.60	1.60	1.20	1.45	1.40	1.10	1.85	1.20
Apr.	0.95	1.56	2.10	1.47	1.60	1.60	1.35	1.50	1.50	1.60	1.60	1.15	1.45	1.40	1.16	1.84	1.15
May	0.92	1.67	1.91	1.41	1.60	1.60	1.35	1.50	1.50	1.60	1.60	1.19	1.45	1.37	1.20	1.70	1.14
June	0.90	1.98	1.52	1.40	1.60	1.60	1.35	1.46	1.50	1.60	1.45	1.20	1.45	1.25	1.20	1.60	1.11
July	0.91	2.02	1.19	1.40	1.60	1.60	1.35	1.50	1.50	1.60	1.40	1.27	1.45	1.23	1.25	1.50	1.12
Aug.	0.94	2.14	1.05	1.44	1.60	1.60	1.35	1.50	1.50	1.60	1.40	1.32	1.40	1.20	1.30	1.40	1.19
Sept.	1.02	2.40	1.12	1.50	1.60	1.60	1.31	1.50	1.50	1.60	1.40	1.39	1.40	1.19	1.37	1.40	1.20
Oct.	0.97	2.39	1.09	1.53	1.60	1.60	1.30	1.50	1.50	1.60	1.40	1.51	1.40	1.12	1.45	1.39	1.15
Nov.	0.94	2.24	1.18	1.50	1.60	1.37	1.31	1.50	1.54	1.60	1.40	1.50	1.40	1.08	1.55	1.29	1.10
Dec.	0.95	2.20	1.25	1.50	1.60	1.30	1.34	1.50	1.60	1.60	1.40	1.50	1.40	1.12	1.60	1.21	1.07



Fluctuations in the Prices of Crude
to Janua



e and Finished Iron and Steel from January 1, 1898,
uary 1, 1915—Gross Tons

Tank Plates at Pittsburgh, in Cents per Pound

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	1.00	1.30	2.22	1.40	1.60	1.75	1.60	1.50	1.60	1.70	1.70	1.60	1.55	1.40	1.15	1.75	1.20
Feb.	1.00	1.47	2.17	1.40	1.60	1.60	1.60	1.50	1.60	1.70	1.70	1.52	1.55	1.40	1.11	1.71	1.20
Mar.	0.97	1.75	2.03	1.47	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.30	1.55	1.40	1.12	1.70	1.18
Apr.	1.02	2.05	1.87	1.57	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.27	1.55	1.40	1.21	1.68	1.15
May	1.10	2.12	1.69	1.60	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.29	1.51	1.39	1.25	1.60	1.12
June	1.10	2.32	1.39	1.60	1.69	1.60	1.60	1.60	1.60	1.70	1.62	1.25	1.48	1.35	1.25	1.45	1.10
July	1.09	2.45	1.16	1.60	1.75	1.60	1.60	1.60	1.60	1.70	1.60	1.33	1.41	1.35	1.30	1.45	1.10
Aug.	1.12	2.55	1.09	1.60	1.75	1.60	1.60	1.60	1.60	1.70	1.60	1.40	1.40	1.34	1.35	1.44	1.18
Sept.	1.15	2.85	1.11	1.60	1.75	1.60	1.44	1.60	1.60	1.70	1.60	1.46	1.40	1.29	1.47	1.40	1.20
Oct.	1.12	2.79	1.07	1.60	1.84	1.60	1.40	1.60	1.60	1.70	1.60	1.50	1.40	1.17	1.53	1.36	1.14
Nov.	1.11	2.52	1.31	1.60	1.82	1.60	1.40	1.60	1.62	1.70	1.60	1.54	1.40	1.13	1.59	1.26	1.08
Dec.	1.16	2.30	1.39	1.60	1.82	1.60	1.45	1.60	1.70	1.70	1.60	1.55	1.40	1.15	1.60	1.20	1.05

Beams at Pittsburgh, in Cents per Pound

Jan.	1.15	1.30	2.25	1.50	1.60	1.80	1.60	1.50	1.70	1.70	1.70	1.60	1.55	1.40	1.15	1.75	1.20
Feb.	1.15	1.30	2.25	1.50	1.60	1.60	1.60	1.50	1.70	1.70	1.70	1.52	1.51	1.40	1.11	1.71	1.20
Mar.	1.15	1.40	2.25	1.52	1.70	1.60	1.60	1.60	1.70	1.70	1.70	1.30	1.50	1.40	1.15	1.70	1.19
Apr.	1.15	1.50	2.25	1.60	1.70	1.60	1.60	1.60	1.70	1.70	1.70	1.27	1.50	1.40	1.21	1.68	1.15
May	1.15	1.50	2.25	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.70	1.27	1.50	1.39	1.25	1.50	1.14
June	1.15	1.70	2.07	1.60	1.60	1.60	1.60	1.60	1.70	1.70	1.62	1.25	1.48	1.35	1.25	1.45	1.11
July	1.15	1.94	1.90	1.60	1.84	1.60	1.60	1.60	1.70	1.70	1.60	1.33	1.41	1.35	1.30	1.45	1.12
Aug.	1.21	2.05	1.74	1.60	2.00	1.60	1.60	1.63	1.70	1.70	1.60	1.40	1.40	1.35	1.35	1.45	1.19
Sept.	1.20	2.25	1.50	1.60	2.00	1.60	1.44	1.70	1.70	1.70	1.60	1.46	1.40	1.34	1.42	1.41	1.20
Oct.	1.20	2.25	1.50	1.60	2.07	1.60	1.40	1.70	1.70	1.70	1.60	1.50	1.40	1.21	1.48	1.37	1.15
Nov.	1.20	2.25	1.50	1.60	2.05	1.60	1.40	1.70	1.70	1.70	1.60	1.54	1.40	1.13	1.57	1.29	1.10
Dec.	1.20	2.25	1.50	1.60	2.00	1.60	1.44	1.70	1.70	1.70	1.60	1.55	1.40	1.15	1.60	1.25	1.07

Wire Nails at Pittsburgh, per Keg of 100 lb.

Jan.	$1.42	$1.43	$3.20	$2.22	$1.99	$1.89	$1.89	$1.75	$1.85	$2.00	$2.05	$1.95	$1.85	$1.71	$1.57	$1.75	$1.54
Feb.	1.45	1.57	3.20	2.30	2.05	1.92	1.90	1.80	1.85	2.00	2.05	1.95	1.85	1.75	1.60	1.75	1.60
Mar.	1.43	1.94	3.20	2.30	2.05	2.00	1.91	1.80	1.85	2.00	2.05	1.95	1.85	1.79	1.60	1.76	1.60
Apr.	1.31	2.05	2.95	2.30	2.05	2.00	1.90	1.80	1.85	2.00	2.05	1.87	1.85	1.80	1.60	1.80	1.60
May	1.31	2.10	2.20	2.30	2.05	2.00	1.90	1.80	1.85	2.00	2.05	1.65	1.82	1.80	1.60	1.80	1.56
June	1.35	2.30	2.20	2.30	2.05	2.00	1.90	1.74	1.85	2.00	1.97	1.70	1.80	1.75	1.60	1.80	1.50
July	1.31	2.42	2.20	2.30	2.05	2.00	1.89	1.70	1.84	2.00	1.95	1.72	1.75	1.70	1.62	1.70	1.52
Aug.	1.26	2.50	2.20	2.30	2.05	2.00	1.71	1.70	1.82	2.00	1.95	1.80	1.70	1.69	1.66	1.65	1.56
Sept.	1.32	2.76	2.20	2.30	2.03	2.00	1.60	1.74	1.86	2.05	1.95	1.80	1.70	1.65	1.70	1.65	1.60
Oct.	1.33	2.87	2.20	2.28	1.89	2.00	1.60	1.80	1.85	2.05	1.95	1.80	1.70	1.64	1.70	1.63	1.60
Nov.	1.28	2.95	2.20	2.17	1.85	1.97	1.62	1.80	1.88	2.05	1.95	1.80	1.70	1.55	1.70	1.59	1.56
Dec.	1.27	2.95	2.20	1.99	1.85	1.87	1.73	1.80	2.00	2.05	1.95	1.85	1.70	1.53	1.72	1.55	1.55

In plotting the lines on the chart, those representing finished material have been derived by multiplying the market prices of finished material per pound by 2240, so that the traversing lines would show the exact price relation between gross tons of all products. In the above tables, however, while pig-iron and steel billet prices are in dollars per gross ton, those for finished material are stated in the usual way, in cents per pound.

The chart starts with 1898, as that was the year in which the depression following the panic of 1893 showed its most disastrous effects upon iron and steel prices. The low points of 1898 make the peaks of 1899 the very striking feature of the chart. After the starved consumption of the panic period, demand developed in 1899 that found capacity entirely inadequate. Almost as striking in the other way are the declines of 1900. In 1901 prices were fairly steady, with advances in the latter part of the year bringing another series of high points in 1902, though these are moderate in comparison with 1899. The sharp decline of 1903 is distinctly shown; the slight further decline extending over nine months of 1904, with advances in the latter part of the year; some reaction in 1905, followed by advances in the latter part of the year and a comparatively stable level for the first half of 1906. Then came a strong movement upward, until substantially the levels of 1902 were reached, followed by recessions after the middle of 1907 in pig iron and billets, but finished material prices were held in the weeks following the panic. The co-operative movement among steel manufacturers modified the decline in the depression of 1908 and in the spring of 1909 came abrupt declines in response to the insistence of some steel manufacturers, particularly of bars, that prices had been kept too high. These cuts stimulated buying and gave the strong upward curve of the second half of 1909. In general, 1910 was a year in which the price movement reversed that of 1909, pig iron reaching again its low points of 1909, while finished materials only retraced part of the distance to the bottom touched after the open market declaration of February, 1909. Steadily declining prices marked 1911. The break in finished material in May is plainly indicated in the pitch of the curves. November was the low month of the year and there was a slight recovery in December. Early in 1912, however, active competition developed a further decline and the low point for the year was touched in February in some products and in March in others. Gradually rising prices marked the late spring and summer and fall months, and on contract material the last three months of that year showed little change. The high prices paid for early deliveries were a prime feature of the first four months of 1913. In May prices for early and for future delivery came closer together and by June premiums on prompt steel had practically disappeared. Business fell off as the summer advanced. This became more pronounced later and in the last four months of the year price declines became marked. In 1914 finished materials gradually drooped as consumption fell off. There was an effort to advance prices in August, under the belief that the war would cause an increased call for American steel. This demand was not large, however, and business at home continued to fall off, the lowest prices of the year being reached in December, with many plants operating only about one-third capacity.

Prices used in plotting the charts are those asked by producers for delivery in from one to three months and thus do not represent the extreme prices paid at times, as in late 1912 and early 1913, for prompt delivery.

Arthur G. McKee, Rockefeller Building, Cleveland, Ohio, announces that Robert E. Baker and Donald D. Herr, his business associates for several years, have joined with him in the incorporation of his engineering and contracting business under the name of Arthur G. McKee & Co. A contract has just been taken for relining two stoves for the Thomas Iron Company, Hokendauqua, Pa.

Corrigan, McKinney & Co., Cleveland, Ohio, have placed two additional contracts for steel work in connection with their new blast furnaces. The McClintic-Marshall Company, Pittsburgh, was given the contract for the cast house, power house, ladle house, monorail system, slag granulating plant, and locomotive house. The contract for ore bins and coal trestles was given to the Variety Iron & Steel Works Company, Cleveland.

L. S. Charcoal Pig-Iron Prices for 26 Years

The following table, which has been compiled from quotations in *The Iron Age*, gives the average monthly prices of Lake Superior charcoal pig iron per gross ton, in carload lots, at Chicago, from 1889 to 1914.

	1889	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
January	$20.00	$23.00	$18.50	$17.25	$16.50	$15.50	$13.00	$14.50	$13.50	$12.50	$11.50	$25.50	$19.00
February	19.50	23.00	18.25	17.00	16.50	15.40	13.00	14.00	13.50	11.50	12.50	25.50	17.50
March	19.50	22.50	18.00	17.00	16.50	15.25	13.00	13.50	13.50	11.50	15.75	25.50	17.50
April	19.25	21.50	18.00	16.75	16.50	15.25	12.75	13.50	13.50	11.50	17.00	25.50	18.00
May	18.75	20.50	17.00	16.50	16.50	15.25	13.00	13.50	13.00	11.50	17.25	24.50	17.50
June	18.50	20.50	16.75	16.50	16.00	15.25	13.00	13.50	13.00	11.50	19.50	23.00	17.00
July	18.50	20.00	17.00	16.50	16.00	15.00	13.50	13.50	13.00	11.50	21.50	22.00	17.00
August	18.50	20.25	17.00	16.50	16.00	14.50	13.50	13.50	13.00	11.50	22.50	20.00	17.00
September	18.75	20.25	17.25	16.50	16.00	14.25	14.50	13.50	12.50	11.50	24.25	18.50	17.00
October	19.50	19.75	17.00	16.75	16.00	14.00	15.50	13.50	12.50	11.50	25.00	18.00	17.00
November	20.00	19.25	17.00	16.50	15.75	13.50	15.50	13.50	12.50	11.50	25.50	17.00	17.50
December	22.00	18.75	16.75	16.50	15.50	13.00	16.00	13.50	12.50	11.50	25.50	18.25	18.00

	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
January	$19.25	$25.60	$16.62	$18.50	$20.40	$26.80	$22.50	$19.50	$19.50	$17.87	$16.00	$18.15	$15.25
February	20.25	26.50	15.87	18.50	20.13	27.00	21.38	19.50	19.50	17.50	15.95	18.00	15.25
March	20.65	26.50	15.00	18.50	19.75	26.75	21.25	19.50	19.30	17.50	15.75	18.00	15.25
April	21.50	25.30	15.19	18.50	19.44	26.50	20.30	19.50	19.00	17.50	15.75	18.00	15.45
May	22.80	24.12	15.00	17.75	19.05	27.40	20.00	19.50	18.62	17.25	15.75	18.00	15.75
June	23.50	24.00	14.70	17.00	19.00	27.50	20.00	19.50	18.50	16.80	16.75	16.81	15.75
July	25.00	22.20	14.50	16.50	19.06	27.00	20.00	19.50	18.50	16.50	16.25	15.65	15.75
August	25.75	20.62	14.87	16.40	19.35	27.20	19.50	19.50	18.50	16.50	16.25	14.69	15.75
September	26.00	19.00	14.75	16.87	20.13	27.00	19.50	19.50	18.40	16.50	17.12	15.25	15.75
October	26.00	18.10	15.31	18.25	21.50	26.20	19.50	19.50	18.12	16.50	18.65	15.25	15.75
November	26.00	17.12	16.37	19.20	24.63	25.12	19.50	19.50	18.00	16.50	18.65	15.25	15.75
December	25.25	16.50	17.80	20.00	26.13	24.25	19.50	19.50	18.00	16.37	18.75	15.25	15.75

Wire Rod Prices for Fourteen Years

It would be extremely desirable to give wire rod prices for at least 20 years, but it is found that quotations did not regularly appear in market reports until 1901. The table given below therefore represents the available figures as far as public prices are concerned. They are for Bessemer wire rods, per gross ton, at Pittsburgh, and are averaged from weekly quotations in *The Iron Age*.

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	....	$33.45	$34.70	$30.00	$31.00	$33.75	$37.00	$34.30	$33.00	$33.00	$28.00	$24.37½	$30.00	$25.50
Feb.	....	35.00	35.75	30.00	31.00	34.00	37.00	35.00	33.00	33.00	28.75	25.00	30.00	26.38
Mar.	....	35.50	36.62½	30.80	31.70	34.00	37.00	35.00	33.00	33.00	29.00	25.00	30.00	26.50
Apr.	....	36.00	37.00	31.00	34.00	34.12½	37.00	35.00	29.00	32.50	29.00	25.00	30.00	26.00
May	....	36.80	37.00	30.50	34.00	34.40	37.00	35.00	27.50	32.00	29.00	25.00	30.00	25.50
June	....	37.00	36.62½	29.20	33.30	34.00	37.12½	33.50	27.50	30.80	28.25	25.00	29.50	24.50
July	....	36.00	35.80	28.00	31.87½	34.00	36.50	33.00	29.40	29.25	27.00	25.00	28.30	24.50
Aug.	....	36.00	35.00	28.00	32.10	34.00	36.10	33.25	31.00	28.25	27.00	25.80	28.00	25.00
Sept.	....	35.87½	34.75	27.00	31.12½	34.00	36.00	33.00	31.50	28.00	27.00	27.00	27.37½	26.20
Oct.	$32.75	35.90	34.00	26.00	31.75	34.50	35.40	33.00	31.87½	28.50	26.00	28.50	26.60	25.88
Nov.	33.00	35.50	31.62½	26.75	32.10	35.50	34.00	33.00	32.50	28.12½	25.30	29.75	25.87½	25.25
Dec.	32.62½	34.50	30.50	29.80	32.50	37.00	34.00	33.00	33.00	28.00	24.50	30.00	25.17	25.00

Heavy Melting Steel Scrap Prices, Pittsburgh

The appended table gives the average monthly prices of heavy melting steel scrap at Pittsburgh for 15 years, comprising 1900 to 1914, inclusive. These prices are per gross ton and are averaged from weekly quotations in the Pittsburgh iron market report of *The Iron Age*.

	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	$20.00	$13.00	$17.40	$21.20	$12.50	$16.25	$17.25	$18.95	$12.80	$16.63	$17.69	$13.50	$12.75	$14.95	$13.62
Feb.	21.00	14.50	17.63	21.13	13.50	15.88	16.31	18.06	13.88	15.63	17.25	14.13	12.12	14.19	12.62
Mar.	21.50	16.00	18.50	21.00	14.00	15.90	14.70	18.00	13.19	14.19	16.80	14.35	12.62	14.19	12.12
Apr.	21.00	16.50	19.00	21.50	13.63	16.00	14.75	17.94	12.80	14.00	16.50	13.06	13.06	14.19	12.00
May	17.00	17.00	20.00	21.25	12.13	15.00	14.80	18.10	12.81	14.81	15.30	12.62	13.25	13.55	12.00
June	15.00	17.50	21.25	20.00	11.30	13.90	15.63	18.38	13.13	15.69	15.10	12.95	13.44	12.62	12.00
July	13.00	17.00	21.90	19.70	10.75	14.00	15.75	18.06	14.25	15.90	14.50	13.06	13.34	12.40	12.00
Aug.	12.00	16.00	21.00	18.50	11.38	14.85	16.50	17.75	14.81	16.31	14.31	13.20	13.55	12.37	11.50
Sept.	11.00	15.00	21.50	17.25	11.50	15.88	16.88	17.38	14.25	17.40	14.35	12.50	14.11	12.25	11.31
Oct.	12.00	17.50	21.50	15.30	12.25	16.50	17.13	17.10	15.20	17.94	14.25	12.06	15.85	11.85	10.85
Nov.	12.00	18.00	21.00	13.25	14.25	17.50	18.00	14.88	16.06	17.50	14.25	12.00	15.12	11.44	10.00
Dec.	12.50	17.50	21.00	11.20	16.20	17.63	20.00	13.00	16.70	18.00	13.75	12.31	14.75	11.08	10.75

Powdered Coal in Steam Boilers

The use of powdered coal in steam boilers has been under investigation for some two years by the Quigley Furnace & Foundry Company, Springfield, Mass. Results announced cover four months' comparative tests on a 300-hp. Franklin water-tube boiler. It is stated that the evaporation per pound of coal as fired, with slack coal averaging 12,570 B. t. u. per lb. and 16.84 per cent. ash, was 6.96 lb., with the stoker in use, and 9.02 lb. when using powdered coal, a gain of 29.6 per cent. in evaporation to the credit of powdered coal.

The efficiency of the boiler with the stoker was 58.86 per cent., while with powdered coal it was 73.1 per cent., a gain of 24 per cent. The carbon dioxide in the flue gases was 10.07 per cent. using a stoker, and 14.6 per cent. using powdered coal. The coal used per boiler horse-power per hour was 4.82 lb. with the stoker and 3.43 lb. with powdered coal, a reduction of 28.8 per cent. in favor of powdered coal. The ash trouble appears to have been eliminated with the use of powdered coal, as the "ash removal is accomplished by one laborer in two hours every second week."

James A. Farrell, president United States Steel Corporation, has promised to make an address before the Youngstown Chamber of Commerce at a luncheon to be held in Youngstown, Ohio, March 24, 1915.

Technical Progress in Iron and Steel in 1914

A Review of Metallurgical and Mechanical Developments, Chiefly in the United States —Costs Lowered and Practice Bettered

BY J. E. JOHNSON, JR.

On its technical side the iron and steel industry developed in 1914 the condition which always arises in times of business stress: practically no new construction, little or no revolutionary re-construction of plants, but everywhere attempts to improve the details of operation and the quality of product so as to cut cost on one hand and increase sales, if not profits, on the other. It is probable that in the long run these developments of the lean years have as much effect on the ultimate evolution of the business as the more spectacular progress in construction and reconstruction during prosperous times.

Fuel

Nothing startling is to be recorded in this field, although several important developments are under way. At least one plant of vertical retort coke ovens is in operation, and it is claimed that it is technically successful and that the investment required per ton of coal coked is smaller than in the standard types of ovens; but no details have been published and it is impossible to say at this time whether these expectations will be realized commercially. If they are, the rate at which coke is produced in by-product ovens will increase rapidly, since the high capital charges for such ovens are now the only deterrent to their use. It has been demonstrated in the Chicago district that not only as good by-product coke as beehive can be made, but even better, and that the coking operation is under control so that the coke produced can be suited to the metallurgical uses for which it is intended—something virtually impossible to do except in a limited way, with the beehive oven. This is accomplished with no loss of the valuable by-products, while the gas resulting from the operation when the coke plant is at the steel works is an asset of far greater value than its B.t.u. contents would indicate, since it constitutes almost an ideal fuel for open-hearth and heating furnaces. The results now being secured by attention to the control of the physical quality of the coke, as well as its analysis, in the Chicago district are becoming widely known, and a rapid development in the amount of attention paid to this important matter on the part of the owners and operators of blast furnaces may be expected in the near future.

COAL TAR DYES AND PRODUCER BY-PRODUCTS

A development not unreasonably to be expected also is the use of the coal tar products for the manufacture of aniline dyes and other chemical products which have hitherto been made in Germany. The sudden curtailment of supply from that source is already resulting in steps to initiate their manufacture here, and this manufacture will probably endure even after the conditions which have brought it about have passed away.

Much attention has been paid also to the development of the gas producer both as to size and efficiency. The desirability of superseding the vast number of small units now required with a few large units is very great and attempts are being made to develop a producer which will permit this. Some interest is being manifested also in the recovery of by-products from producers, a field which has been extensively developed in Europe but to which virtually no attention has been paid in this country.

Iron Ore

The very small demand for iron ore during the past year has reacted, as it generally does, upon the price and this in turn upon the efforts to discover new mines, so that no discoveries of new iron ore fields have been made, though there have been considerable developments in existing ones.

The effect of the physical condition of the ore on the operation of the furnace is exciting a growing interest, The extremely detrimental effects of excessively fine ore have long been known, but their cause has been more fully realized in the last year, as being due to the great solution loss of coke which they bring about and the desirability of agglomerating these ores so as to prevent their running freely through the coke is becoming more and more widely recognized, especially since the cellular sinters produced by two types of down draft sintering machines have shown results on the furnace which confirm the claims made for the improved condition of the ore to a far greater extent than any one would have thought possible a year or two ago. At least one plant has under contemplation the possibility of sintering a portion of its fine ore by mixing it with the flue dust and so securing a larger tonnage of this desirable material. On the other hand, the detrimental effect of re-charging fuel dust without treatment is becoming more generally recognized and it seems likely that that practice will eventually die out.

Gas Cleaning and Combustion

There has been in the past year a rapidly growing recognition of the value of clean gas for boilers, and particularly for stoves, and the interest in methods of gas cleaning is increasing rather than diminishing. Several successful plants are in operation, as is well known, but in examining these with their high construction cost, their rather large power consumption and their delivery of cold gas saturated with moisture, one is impressed with the idea that they constitute *a* way rather than *the* way to accomplish the desired purpose. The latter remains to be developed.

Along with the interest in preparation of the gas has gone a very wide interest in the subject of combustion and the design of stoves. Stove checkers are being made very much smaller at all plants where clean gas is available, and in at least one plant corrugated checkers are being used to present more heating surface. This would have been suicidal in the days of dirty gas since the rapidly-gathering coating of dust upon these corrugated surfaces would have shortly obstructed the checkers so as to put the stove out of

commission. At one plant valuable experiments on the conductivity of firebrick have shown definitely that second quality firebrick have greater conductivity than first quality and accordingly the former are being used for checkers in the stoves at that plant, since it is obvious that the greater the conductivity the greater the quantity of heat which can reach the interior of the brick and be stored there in a given time. Tests of the efficiency of blast furnace stoves have been made within the last year or two. These have shown room for a great improvement on the old types of stoves, and such tests as have been made on the more modern types of better design have shown a considerable improvement.

THE P. S. S. SYSTEM

In Europe also this subject has received acute attention. At the autumn meeting of the (British) Iron and Steel Institute A. Spannagel described the system briefly known as P.S.S. from the names of its three inventors or designers: Pfoser, Strack, Stumm. Briefly the reasoning which led to the development of this system is as follows:

The cooling of stoves in ordinary practice while on blast takes place in very much shorter time than their heating. Calculation of the velocity of the blast and of the gas shows that the former travels at a much higher rate through the stove than the latter. It is becoming more and more recognized that velocity is a factor second only to temperature in determining the amount of heat transmitted from a fluid to a unit of surface in a given time; therefore the lower velocity of the gas is obviously the reason for the lower rate of heat transmitted. Experiments were then begun to increase the gas velocity through the stove. The first effect was to increase the outlet temperature and lower the efficiency, on account of the increased volume of gas passed through the stove; but this action reached a maximum and finally began to reverse on account of the great gain in heat transmitting power due to increased velocity, the effect of which is to scour clean the surfaces of the heat absorbing material and prevent their becoming covered with a nearly stationary film of fluid at an intermediate temperature, which acts almost like a complete nonconductor. Experiments were then tried with the use of cold blasts discharged into the combustion chamber to increase the velocity. Subsequently an air blast supplied by a fan was substituted, which of course required far less power. Suitable changes in the burner, the area of the chimney outlet, etc., were made, and as a result of the whole development it is claimed that a stove may now be heated up as quickly as it is cooled down and that two stoves are therefore enough for a furnace, one on blast and one on gas. Nothing has been published concerning any developments in this country along this line, but the reasoning is undoubtedly correct, and it is probable that this matter will be taken up here in the immediate future.

Attention is also being paid to the correct distribution of the blast into the checkers and the withdrawal of the burnt gases from them. One plant is building stoves with three cold blast inlets spaced at equal angles around the base of the stove. This is a two-pass stove with central combustion chamber, a type which has much to recommend it but one with which it has been impossible in the past to secure a uniform distribution of the blast and gases through all the checkers.

BETTER COMBUSTION UNDER BOILERS

Combustion under boilers has also received much attention. The use of the Bone system in England whereby gas and air are mixed and forced under pressure through a porous surface like a porous firebrick has brought about interest in the similar system previously patented in this country by Professor Lucke of Columbia, which is now being developed. So far as known no installations of this kind have been made at blast furnaces or steel works, but with the large use of gas fuel and especially since clean gas is now being so widely employed, there is no reason why this system should not be used for iron and steel works boilers. The Terbeck system has been actually applied in Germany and in England and I believe at one plant in this country. This consists virtually in a Bunsen burner designed for blast furnace gas, in which the ejector action of the gas jet draws with it a correctly proportioned amount of air and secures thorough mixing in the base of the burner before discharging the gas into the combustion space. "Striking back" of the flame is prevented by the high velocity through the burner. The great advantage claimed for this system is that the supply of air is independent of chimney draft and is therefore correctly proportioned at all times, while the chimney draft can be cut down with a damper to the point which will only cause the passage of the correct quantity of burned gas through the setting without drawing in large quantities of air through it. The principle on which this burner operates is undoubtedly correct and there seems to be no reason why it should not be widely used. Boiler efficiencies averaging 80 per cent. are claimed to have been obtained with it in England, which are very much higher than the best that are given as the result of authentic tests in this country.

Blowing Engines

Great interest has been taken in this subject throughout the year. The gas engine a few years ago threatened the steam engine with extinction because of its extremely small gas consumption and the great value of the gas saved for power development at steel mills, especially because blast furnace gas is almost an ideal fuel for gas engines. The advocates of the turbo blower are now vigorously declaring that while they cannot equal the gas engine in economy the total cost of plant is so much less with their system than with gas engines that the lower fixed charges far more than offset the difference in fuel. In the meantime the steam engine builders have not been idle and have developed blowers adapted to run at higher speeds with greater air valve efficiency and under the conditions of steam pressure and super-heat, which are absolutely necessary to the economy of the turbo blower. The builders of the highest class of these engines now claim that they can almost equal the turbo blower plant in first cost, because while their machine costs more than the turbo blower the latter requires more steam and more boilers than a well designed blowing engine, on account of the relatively poor efficiency of the blower end of the turbo blower. Practically equaling the turbo blower installation in first cost and fixed charges, they argue that they can beat it in steam consumption for the reason mentioned. The steadiness of the blast claimed as one of the great advantages for the turbo blower has proved somewhat of a boomerang, since the only tests made to date seem to indicate the best furnace performance with the reciprocating engines. Very sharp differences of opinion came out on the subject in the discussions before the American Institute of Mining Engineers in early October, and before the American Iron and Steel Institute in Birmingham later in the same month. Operating men who are not steam experts are greatly confused by the revival of claims of the different builders, and many of them feel that they would be grateful for more fact and less argument. It will probably develop in the last analysis that to this question as to so many

others there is no one answer but that one type of apparatus is best for one set of conditions and a different one for another, while for a great many a combination of two may be the most desirable.

The Blast Furnace

Practice with the blast furnace itself has probably advanced more rapidly in the past year than in many preceding years. The possibility of obtaining economically much greater stove heats than were available before the day of washed gas has produced a decided alteration in practice. Interest in the type of filling to be preferred is very active, although no new types of stock distribution have actually been installed in this country in the year as far as known.

FURNACE FILLING

At the autumn meeting of the (British) Iron and Steel Institute a paper was read, describing a system of filling blast furnaces by the use of buckets hanging from a suspended rail and propelled at the bottom by individual electric motors but hoisted up the incline by a continuous rope to which the bucket is gripped at the bottom and from which it is released at the top. No details are given of the method by which a symmetrical distribution of the stock in the top of the furnace is obtained, and it is therefore impossible to pass on the value of the device. The use of relatively small individual loads is to be preferred from the point of view of convenience in making up the charge, etc., but practically the objections to the relatively large skip loads used in American practice do not seem to be great, and it seems doubtful if the electric telpherage system of filling will ever take much hold in the United States.

TWO AMERICAN PAPERS OF 1914

Questions of the thermal balance of the furnace and of solution loss of coke are enlisting great interest as mentioned above.

Two notable papers on blast furnace practice have appeared during the year, accompanied by discussions equally notable, both before the American Iron and Steel Institute. The first, that of H. A. Brassert, at the May meeting in New York, gave many valuable results of monthly furnace performance at one of the largest plants in the country and also of very interesting and important tests on solution loss of coke in a stream of carbon dioxide at different temperatures, these being the first data of this kind published in this country as far as known. The relationship between the quality of the coke and the type of the furnace in which it is used was traced, and a valuable set of furnace lines was given, showing the progress from the early nineties to the present. These showed the very great increase in top and hearth diameter with the much smaller increase in bosh diameter and the accompanying increase in the angle and decrease in the hight of the bosh, which have been used to obtain modern outputs. It seems probable that the most recent achievements in this line have been made possible by the unprecedentedly high quality of the coke with which the furnaces are operated and the high blast temperature available rather than by the blast furnace lines alone. The second paper was that of F. E. Bachman, describing in detail the results of what was probably the most extensive experimental run on a blast furnace ever conducted. The object was to prove beyond possibility of cavil the suitability of ores containing titanium for use in the blast furnace. The test was entirely successful in demonstrating that ore containing large percentage of this material could be worked, and that it was fluxed out of the furnace without difficulty. A small percentage went into the iron, contrary to the theory that the temperatures obtainable in the blast furnace are not high enough to reduce any portion of its extremely refractory oxide. The fact that such reduction took place is undoubtedly due to the assistance of the solvent action of the iron in conjunction with the reducing action in the hearth. These experiments were notable and commendable from the scientific point of view and also from the practical one, in the last analysis, for the reason that continuous and extensive use was made of accurate pyrometers for determining the temperatures of the iron and slag, which exert a controlling influence on the economy of the furnace. The data published will be of use to many, particularly on account of containing this information.

IMPROVING THE QUALITY OF CAST IRON

As to the product of the blast furnace, there has been in the year one development of scientific interest, concerning the commercial development of which it is not suitable for the present writer to speak extensively here on account of personal interest in the matter. It consists in the production of a coke iron similar but superior to charcoal iron in its characteristics of strength, close grain, chilling power and the like, by injecting oxygen into the iron. Several hundred tons of such iron have been produced and after undergoing suitable tests, sold to consumers, who have shown much interest in spite of the extremely dull times. By another year it is expected that there will be available data of commercial importance in this direction.

Steel Manufacture

This year has seen the building of several small open-hearth steel plants, with blooming mill and finishing mills, at various points in the Central West. This has been the most important and suggestive new construction of the year and it seems to portend the development of the moderate sized merchant steel plant without accompanying blast furnaces very similar to the puddling and rolling mills of twenty years ago. It indicates among other things that the independents, even the smaller ones, are not afraid of "predatory competition" from any single interest or combination of interests in the business.

In regard to new processes in manufacture there has been little new, but there has been an active discussion of the merits of the duplex as against the open hearth in this country and also of both of these against the Talbot process, in Germany. Dr. Friedrich Schuster of Witkowitz, Austria, published before the (British) Iron and Steel Institute a monumental paper describing the results of extensive tests on the Talbot, duplex and the straight open-hearth processes, with the result of reaching the definite and positive conclusion that for the conditions at Witkowitz the Talbot process possesses by far the greatest number of advantages. In spite of this fact the straight Talbot process has not developed to any great extent in this country, although some of the most successful plants consist of very large tilting furnaces supplied with blown metal from the Bessemer plant near by. The fact probably is that owing to higher fixed charges in this country it pays to secure greater output by sacrificing the silicon and carbon in the Bessemer instead of using them as a fuel for the reduction of iron ore in the Talbot or the open hearth. It is also very probable that the much lower average phosphorus in the Northern district than prevails in Europe has a decided bearing in the final decision of this matter.

A paper on the duplex process was read in this country at the October meeting of the American Institute of Mining Engineers, but it proved to be impossible to obtain as extensive a discussion of it as had been hoped, apparently for the reason that steel makers were not ready to commit themselves as yet, ex-

cept in very general terms. A process for the improvement of Bessemer steel in particular has been brought out, and some general information about it has been published, but not in sufficient detail as to the results obtained to enable one to form an opinion of its probable ultimate value. This is the Goldmerstein process for the removal of phosphorus and sulphur by the use of sesquifluoride of iron or manganese compounds which break up at high temperatures, releasing the fluorine, which attacks the sulphur and phosphorus, forming volatile fluorides which pass off from the bath as a gas and cannot be re-introduced into it by reducing action as they can from slag. The data given would indicate that a considerable purification can be made at a cost of a few cents per ton, but so far as known no results of actual commercial performance have been given. This process may become important industrially if it justifies the hopes of its inventor.

ELECTRIC STEEL

The electric furnace continues to advance as a means for producing high grade steels and for melting scrap for the manufacture of steel castings, and developments are still proceeding in the use of the electric furnace as a final step in refining steel produced by other processes. The possibility of maintaining any desired temperature, even in a vacuum if desired, and of melting slags of such great basicity as to purify the metal beyond the limits possible in combustion furnaces, promises great usefulness, but there have been no innovations along this line in the past year.

Descriptions have appeared of the Moffatt-Irving steel furnace which utilizes powdered fuel and very fine iron ore for the direct production of cast iron and steel. The advantage of not requiring a solid fuel and lump iron ore is very great, especially in certain districts, and the results published show that the purpose intended has been accomplished but the data as to current consumption are not sufficiently complete to permit of forming a view of the commercial value of the process. It seems extremely unlikely that the electric furnace will ever be an important competitor of the blast furnace where solid fuel is available for the latter.

The Recovery of Power from Slag

An interesting paper on this subject was published at the autumn session of the (British) Iron and Steel Institute describing the development at Middlesbrough of an apparatus for generating low pressure steam for use in a low pressure turbine. Slag entering a closed vessel through a seal is granulated and taken out by a bucket elevator which discharges to another elevator working outside the seal, by which the slag is delivered to cars for final disposal. The steam generated in the sealed chamber cannot be used directly in the turbine, because of the development of corrosive gases, particularly hydrogen sulphide and sulphur dioxide from the sulphur in the slag; as a result this steam passes into an evaporator, where it is condensed and an equal weight of steam produced from pure water, which can be used in the turbine. Considering that the slag contains only about 1-20 of the heat obtainable from the combustion of an equal weight of coal, and that probably not over two-thirds of this can be realized, it becomes a question whether the power recovered would pay the fixed and operating charges on the very considerable investment required. This also is a question of locality, to be settled for each plant on its own merits. The apparatus is an interesting one and much painstaking work has evidently been put upon it. But it is doubtful if the commercial result obtained is as great as could have been achieved from an equal amount of effort extended in some more favorable direction.

The Quality and Nature of Steel

The almost endless subject of the relation between the different micro-constituents of steel and its physical and magnetic properties has developed perhaps more rapidly during 1914 than other previous years. A large part of the interest has centered around the existence of the so-called beta iron, which has been categorically denied by the majority of English metallurgists and is just as stoutly maintained by some eminent American ones. Data have been brought forward by the officers of the Bureau of Standards at Washington, as a result of extensive and extremely accurate investigations, which appear to make the position of the British contestants very difficult to maintain. On account of the peculiar nature of manganese steel and its relation to the subject of beta iron, much interest has been evinced in the fundamental nature of this material, concerning which several papers have been published, though unfortunately they are entirely beyond the comprehension of the great majority of the readers of *The Iron Age*, including the writer of this article. At the May meeting of the American Iron and Steel Institute a very interesting and informing set of micro-photographs were shown illustrating the action of the different micro-constituents of steel during the process of wire drawing. On account of the lucid explanation with which they were accompanied these were viewed with more interest and comprehension by the whole audience than is usual at the presentation of such papers. At the close of the year Dr. John A. Mathews presented before the American Society of Mechanical Engineers a valuable and interesting paper concerning the hardening of various steels.

In the steel works there has been great activity in testing and in co-ordinating the results of tests and works practice, so as to secure an improved quality of material and particularly to secure tests which should be a more accurate reflection of the fundamental or dynamic quality of the material than are most of the older tests. With this has gone a steady and great improvement in steel works practice from the point of view of the quality of the material produced.

RAIL IMPROVEMENT

The situation with regard to steel rails is not greatly changed, although there has been a betterment all along the line, due perhaps to close co-operation between the engineers of maintenance of way and engineers of tests on the railroads with the steel works. One of the few new things of the year is the development by the Lackawanna Steel Company of the process for milling off the top and bottom surfaces of rail blooms at a point between the roughing and finishing mills. The rail is passed by feed rollers between two large milling cutters of high-speed steel some 4 or 5 ft. in diameter and running at a speed of considerably more than a mile a minute. These mill off the top and bottom surfaces of the rail bloom and remove seams, cracks and roughnesses which have been developed in the earlier processes of rolling. Incidentally this process removes a large portion of the metal which has been decarbonized in the heating furnace and thereby brings to the surface metal of normal carbon and better capable of resisting wear than the decarbonized metal removed. The improvement in the finished product is very great as compared with rails rolled in the same mill when this process is not used, and the result has been a considerable reduction in the seconds. This reduction is sufficient to offset the cost of the operation, and in consequence the Lackawanna Steel Company sells the improved rails at no advance in price over those not so treated.

Transverse fissures in rails, which develop from the inside and increase in area until, without ever show-

ing at the surface, they make the breakage of the rail inevitable, continue to excite the liveliest interest both among the steel makers and the railroads. These defects, which from being hidden are particularly dangerous, occur almost exclusively in open-hearth rails and they are therefore a deep disappointment to all parties who had hoped that the open-hearth rail would furnish the final solution of the long standing problem of strong, tough, durable rails. The cause of these fissures is a matter of decided difference of opinion. Some authorities maintain that they are started by excessive gagging at the straightening press, while others claim that they are developed in service on account of the extremely severe strains set up by modern wheel loads. It seems to the writer that the greater ductility of open hearth as compared with Bessemer steel will probably be found a factor in the eventual solution of the question.

Indications from such results as are now available indicate that the heavier sections of rails are much freer from these defects, which would scarcely be true if they were due to bad mill practice, but would be comprehensible if they are due to the severity of the stresses received in service. At all events there is no doubt that the steel of the rails which develop these serious defects, even to the extent of several in one rail, is of excellent quality, as shown by physical and chemical tests of pieces cut from them.

Welfare and Accident Prevention Work

Mention should not be omitted in this review of the amount and character of the welfare work that has been carried on by the large iron and steel concerns under the leadership of the American Iron and Steel Institute. Those who are members of that organization and receive its bulletins cannot fail to be impressed not only with the enormous expenditures the various companies are making for the betterment of the condition of their workers and the workers' families, particularly the children, but also the degree of painstaking thought and attention which has evidently been devoted to this subject by those high in authority, since otherwise the expenditures which have been made would never have been allowed. It seems a great pity that a knowledge of this practical betterment work should be confined within such relatively narrow limits, when the almost microscopic amount that is being accomplished by professional uplifters is heralded to the skies as bringing about the dawn of a new era. It seems lamentable that the iron and steel business, which in the mind of the "man in the street" stands for the lowest order of money grubbing, should not take more pains to have the real facts in regard to its accomplishments for humanity known, if not for its own sake at least for the removal of the crass ignorance which so widely prevails. It would seem that it should be easy for the American Iron and Steel Institute to father a campaign of publicity which should let not only its own members but the public generally know what it is striving for and the magnificent results actually being accomplished. The same remarks apply to accident prevention. It is extremely doubtful if all the legislation enacted to date has accomplished as great a reduction in the percentage of accidents in industrial life as the sudden (if too long delayed) realization of those at the head of industrial corporations that their responsibility extended much farther in this direction than they had believed, and that it was poor business to permit the injury or death of workers who perhaps had been trained in their service for years if by any expenditure of money or care such injuries could be prevented. It is of some interest that the larger iron and steel concerns have abated none of their activities in these directions in spite of the great financial pressure upon all of them.

Lower Costs and Better Practice

In conclusion we may say that the results of this dull year's developments will be seen in lowered costs, bettered practice, and betered material, for years to come, while as a result of this year's happenings we shall probably have forced on us foreign trade, which will eventually prove to be of great benefit. With these considerations and with all underlying conditions so much improved over what they were five months ago, we can well look forward with hope and even cheerfulness to the prospects of 1915.

Zimmerman Steel Company to Move to Davenport

The Zimmerman Steel Company, Lonetree, Iowa, has arranged to remove its plant and business to Davenport, Iowa, in the spring. The company has purchased 10 acres and taken an option on 10 acres more. It is now erecting large iron and steel foundry buildings, assembly buildings and office and other buildings, in the expectation of making the plant one of the most complete and modern of its kind in the West. The company manufactures the Mighty Monarch line of stump pullers and several types of wagon scales and does a large business in gray-iron and steel castings. The plant will be located near the Bettendorf shops, and J. W. Bettendorf will take a large interest in the company and become one of its directors.

The officers of the Zimmerman Steel Company have realized for some time that its business has been seriously handicapped by its location in a small interior Iowa town where labor is not plentiful and freight rates are high. The removal will also effect other substantial economies. The plant at Lonetree was established 20 years ago and is, therefore, not as efficient as a modern plant constructed according to the latest improvements, such as the new one will be, which will be laid out to produce a given unit of product in the quickest and best manner and at the minimum of cost.

The company was founded by William F. C. Zimmerman, who began the manufacture of a stump puller of his own invention. For a time the company made its own gray-iron castings and purchased its steel castings, but about six years ago added a Bessemer converter and has since then made its own steel castings. Mr. Zimmerman has drawn members of his family into the service, so that for several years he has had associated with him three of his five sons and his son-in-law, each of whom is in charge of some department of manufacture and sale.

Some Railroad Problems to Be Solved

The Railway Business Association, 30 Church street, New York, of which George A. Post is president and Frank W. Noxon is secretary, has issued a circular expressing gratification with the success of those who have urged upon the public the needs of the railroads. Other railroad problems are now faced which press for attention and are enumerated as follows:

"Can an adjustment be reached between Federal and State regulation? Can the United States Government be persuaded to pay the railroads just and reasonable rates upon service fairly and impartially measured for carrying the mails? Can State legislatures be prevailed upon to delegate and leave permanently to commissions the adjustment of details in such matters as size of train crews, safety appliances, convenience of passengers and shippers and other problems which require elastic regulations and continuous discretion of specialists and which involve expenditures? Can local communities be led to punish trespassing upon the railroad right of way and thus reduce the unnecessary deaths and injuries due to this cause from the frightful American total to the practical immunity obtained in other countries?"

Metal, Tin-Plate and Sheet Prices for Seventeen Years

Monthly Averages Computed from the Weekly Market Quotations of "The Iron Age" in the Period of 1898-1914

(With Supplement)

The accompanying supplement shows by plotted lines the fluctuations in prices of the more important metals, tin plate and sheets in the period from 1898 to 1914, inclusive. The prices used for this purpose are the computed monthly averages of the prices of carloads, at New York, for metals and at Pittsburgh for tin plate and No. 28 black steel sheets, given in the metal market reports of *The Iron Age* week by week. The columns of figures alongside the chart give the values. The column nearest the chart gives tin in cents per pound; the middle column, copper in cents per pound, and the outside column represents lead, spelter and steel sheets in cents per pound and tin plate in dollars per base box. The following tables give the monthly averages on which the chart is based:

Lake Copper, at New York, in Cents per Pound

	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	11.00	14.02	16.21	16.90	11.45	12.13	12.62	15.18	18.78	24.41	13.90	14.56	14.00	12.81	14.50	16.98	14.85
Feb.	11.19	17.66	16.25	16.97	12.47	12.80	12.34	15.25	17.94	25.10	13.13	13.37	13.78	12.75	14.41	15.55	15.00
Mar.	11.95	17.55	16.41	17.00	12.12	14.31	12.60	15.25	18.50	23.38	12.85	12.90	13.75	12.58	14.88	15.05	14.79
April	12.05	18.56	17.00	17.00	11.97	14.85	13.19	15.18	18.62	24.62	13.09	12.94	13.31	12.41	16.00	15.67	14.75
May	12.04	18.65	16.80	17.00	12.10	14.75	13.28	15.00	18.70	24.10	12.88	13.21	13.06	12.33	16.30	15.91	14.40
June	11.85	18.20	16.31	17.00	12.23	14.56	12.74	15.00	18.69	23.94	13.00	13.50	12.88	12.71	17.53	15.42	14.12
July	11.59	18.37	16.31	16.97	11.94	13.73	12.62	15.03	18.47	21.95	13.00	13.34	12.66	12.78	17.54	14.78	13.70
Aug.	11.85	18.50	16.55	16.50	11.59	13.35	12.50	16.07	18.65	18.94	13.71	13.56	12.93	12.75	17.73	15.86	12.86
Sept.	13.25	18.47	16.75	16.50	11.60	13.58	12.67	16.12	19.31	16.41	13.80	13.50	12.81	12.65	17.77	16.77	12.66
Oct.	12.37	18.03	16.73	16.71	11.71	13.42	13.09	16.62	21.81	13.80	13.81	13.19	12.84	12.53	17.80	16.85	11.73
Nov.	12.69	17.00	16.75	16.82	11.44	13.25	14.22	16.90	22.50	13.94	14.44	13.44	12.98	12.80	17.70	16.16	12.00
Dec.	12.79	16.69	16.87	14.71	11.61	12.30	14.87	18.75	23.06	13.48	14.53	13.80	13.00	13.84	17.69	14.88	13.35

Spelter, at New York, in Cents per Pound

Jan.	3.75	4.90	4.55	4.08	4.28	4.82	4.95	6.17	6.48	6.90	4.54	5.15	6.26	5.55	6.52	7.15	5.29
Feb.	3.79	5.68	4.69	3.94	4.18	5.00	4.95	6.12	6.09	7.00	4.78	4.99	5.89	5.56	6.71	6.45	5.40
Mar.	4.00	5.99	4.60	3.89	4.29	5.36	5.05	6.06	5.96	6.92	4.76	4.81	5.72	5.65	6.98	6.26	5.28
April	4.00	6.25	4.71	3.94	4.41	5.65	5.22	5.97	6.05	6.81	4.68	4.94	5.60	5.51	6.86	5.77	5.18
May	3.95	6.72	4.52	3.97	4.50	5.75	5.14	5.55	5.95	6.51	4.60	5.12	5.20	5.50	6.86	5.47	5.06
June	4.65	6.02	4.27	3.95	4.88	6.00	4.79	5.32	6.14	6.45	4.56	5.39	5.19	5.63	6.99	5.18	5.09
July	4.51	5.79	4.24	3.90	5.23	5.95	4.85	5.38	5.98	6.15	4.46	5.35	5.20	5.79	7.26	5.38	5.02
Aug.	4.35	5.55	4.17	3.92	5.46	5.94	4.85	5.66	6.06	5.71	4.71	5.74	5.26	6.04	7.19	5.75	5.60
Sept.	4.62	5.40	4.10	4.02	5.45	6.00	5.06	5.83	6.19	5.28	4.76	5.85	5.53	6.03	7.53	5.82	5.50
Oct.	4.61	5.37	4.10	4.20	5.48	6.05	5.17	6.05	6.18	5.45	4.81	6.09	5.69	6.20	7.57	5.42	4.97
Nov.	5.09	4.64	4.20	4.32	5.29	5.68	5.49	6.17	6.36	5.10	5.03	6.32	5.95	6.60	7.48	5.29	5.12
Dec.	5.13	4.68	4.19	4.35	4.91	5.15	5.80	6.50	6.62	4.39	5.17	6.35	5.80	6.44	7.33	5.18	5.71

Lead, at New York, in Cents per Pound

Jan.	3.66	4.02	4.70	4.37	4.02	4.10	4.39	4.56	5.86	6.30	3.73	4.19	4.70	4.50	4.41	4.35	4.11
Feb.	3.69	4.53	4.70	4.37	4.10	4.10	4.40	4.50	5.56	6.31	3.75	4.07	4.63	4.46	4.00	4.35	4.06
Mar	3.71	4.37	4.70	4.37	4.10	4.44	4.50	4.45	5.35	6.31	3.88	4.02	4.51	4.41	4.08	4.35	3.97
April	3.61	4.30	4.70	4.37	4.10	4.59	4.50	4.50	5.39	6.16	4.02	4.19	4.40	4.44	4.20	4.40	3.82
May	3.64	4.42	4.22	4.37	4.10	4.37	4.48	4.50	5.90	6.02	4.26	4.32	4.37	4.40	4.20	4.37	3.90
June	3.86	4.45	3.90	4.37	4.10	4.25	4.22	4.51	5.94	5.75	4.45	4.36	4.38	4.46	4.50	4.35	3.90
July	3.95	4.55	4.03	4.37	4.10	4.12	4.17	4.56	5.80	5.24	4.50	4.35	4.40	4.50	4.67	4.37	3.90
Aug.	3.99	4.56	4.26	4.37	4.10	4.12	4.15	4.64	5.78	5.12	4.59	4.36	4.40	4.50	4.54	4.64	3.87
Sept.	3.99	4.60	4.36	4.37	4.10	4.26	4.20	4.85	5.92	4.84	4.54	4.39	4.40	4.49	5.04	4.73	3.86
Oct.	3.81	4.59	4.37	4.37	4.10	4.40	4.20	5.07	5.94	4.64	4.34	4.39	4.40	4.31	5.06	4.52	3.52
Nov.	3.70	4.58	4.37	4.37	4.10	4.25	4.51	5.48	5.97	4.45	4.39	4.40	4.44	4.31	4.66	4.33	3.68
Dec.	3.62	4.65	4.37	4.19	4.10	4.19	4.60	5.96	6.19	3.76	4.24	4.56	4.50	4.45	4.32	4.06	3.80

Tin, at New York, in Cents per Pound

Jan.	13.77	22.12	26.00	26.60	23.38	27.76	28.75	29.18	36.36	42.14	27.43	28.19	32.61	41.20	44.58	50.34	39.12
Feb.	14.04	24.25	29.71	26.55	24.73	29.14	27.98	29.49	36.48	42.16	28.74	28.44	32.65	43.34	43.56	48.71	39.82
Mar.	14.26	23.86	32.42	25.95	26.16	30.06	26.19	29.21	36.62	41.29	30.46	28.75	32.51	41.10	42.76	46.93	38.03
April	14.41	24.82	30.85	25.94	27.29	29.69	27.99	30.43	38.86	40.84	31.79	29.35	32.83	42.05	43.64	49.04	36.10
May	14.54	25.61	29.25	26.82	29.26	29.36	27.76	30.04	43.08	43.01	29.84	29.07	33.05	43.32	45.98	49.06	33.21
June	15.05	25.69	30.00	28.22	29.29	28.30	26.14	30.36	38.97	42.65	28.18	29.26	32.79	46.25	47.44	45.01	30.60
July	15.60	28.72	32.76	27.41	28.28	27.60	26.28	31.71	37.18	41.15	28.92	29.05	32.99	43.23	44.70	41.32	35.65
Aug.	16.14	31.40	31.13	26.90	28.14	28.00	26.74	32.85	39.90	37.35	29.99	29.96	33.92	43.38	45.86	41.63	48.34
Sept.	16.02	32.40	29.63	25.04	26.55	27.06	27.27	32.21	40.32	37.22	28.91	30.00	35.17	39.69	49.16	42.63	31.13
Oct.	17.25	31.35	28.46	24.62	25.76	25.83	28.53	32.47	42.90	32.33	29.44	30.41	36.76	41.23	50.07	40.38	30.25
Nov.	18.07	28.52	28.10	27.47	25.43	25.35	29.00	33.46	42.70	30.81	30.43	30.74	37.38	43.08	49.87	39.75	33.28
Dec.	18.20	25.19	26.84	24.39	25.33	27.53	29.27	35.84	42.62	27.92	29.13	32.91	38.21	45.03	49.86	37.12	34.01

Tin Plate, at Pittsburgh, in Dollars per Box

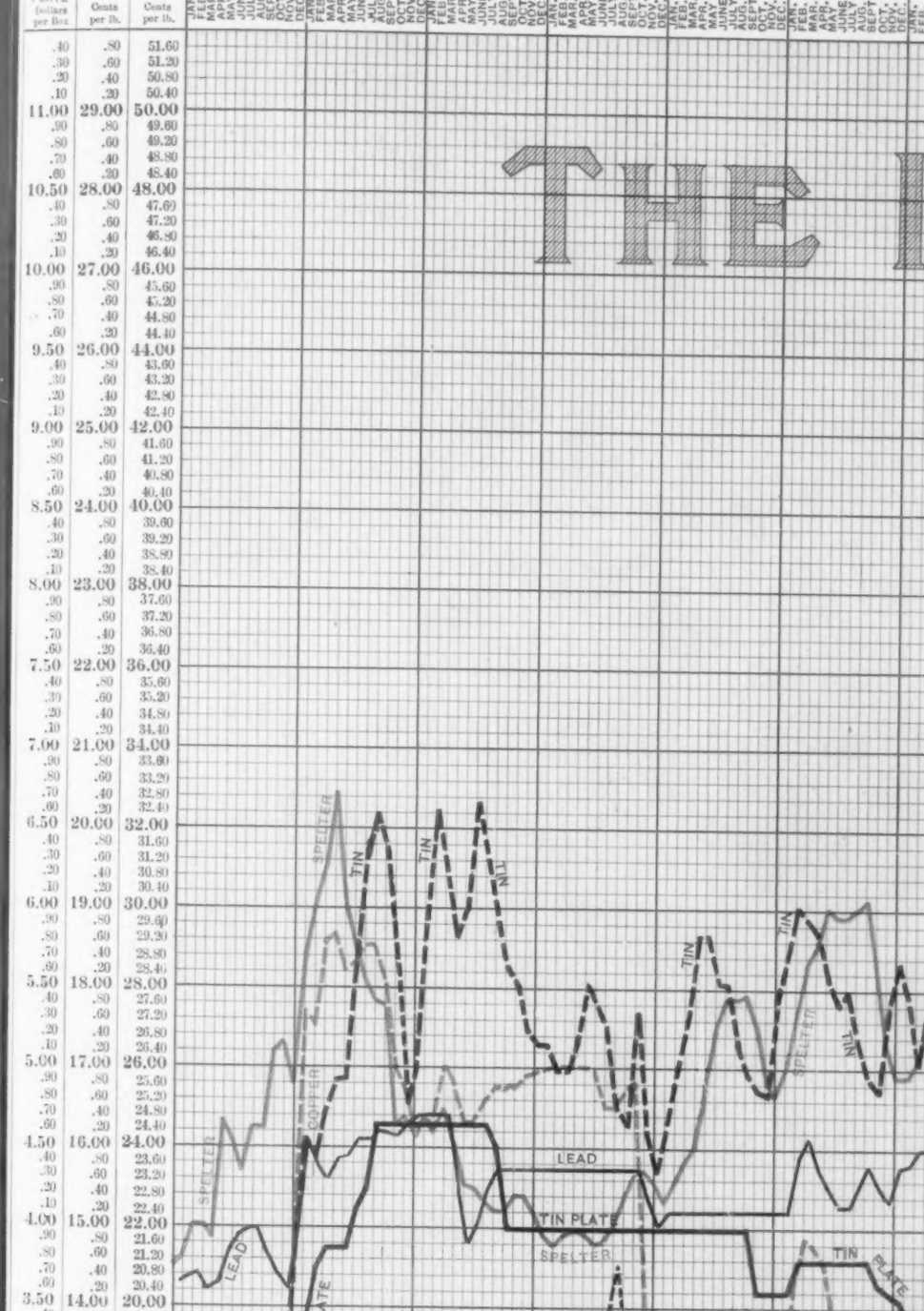
Jan.	$2.95	$3.00	$4.65	$4.00	$4.00	$3.60	$3.56	$3.55	$3.47	$3.90	$3.74	$3.70	$3.60	$3.60	$3.40	$3.60	$3.32
Feb.	2.90	3.38	4.65	4.00	4.00	3.60	3.45	3.55	3.50	3.90	3.70	3.70	3.60	3.67	3.35	3.60	3.29
Mar.	3.00	3.75	4.65	4.00	4.00	3.80	3.45	3.55	3.50	3.90	3.70	3.53	3.60	3.70	3.30	3.60	3.30
April	3.00	3.87	4.65	4.00	4.00	3.80	3.45	3.55	3.57	3.90	3.70	3.40	3.60	3.70	3.30	3.60	3.30
May	3.00	3.87	4.65	4.00	4.00	3.80	3.45	3.55	3.66	3.90	3.70	3.40	3.60	3.70	3.33	3.60	3.30
June	2.99	3.87	4.65	4.00	4.00	3.80	3.45	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.40	3.60	3.30
July	2.94	4.12	4.65	4.00	4.00	3.80	3.41	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.43	3.60	3.27
Aug.	2.93	4.23	4.65	4.00	4.00	3.80	3.30	3.55	3.75	3.90	3.70	3.40	3.60	3.70	3.50	3.55	3.41
Sept.	2.98	4.65	4.50	4.00	4.00	3.80	3.30	3.55	3.75	3.90	3.70	3.40	3.60	3.67	3.58	3.50	3.35
Oct.	2.98	4.65	4.00	4.00	4.00	3.80	3.30	3.34	3.75	3.90	3.70	3.50	3.60	3.52	3.60	3.50	3.24
Nov.	2.98	4.65	4.00	4.00	3.60	3.65	3.39	3.34	3.90	3.90	3.70	3.56	3.60	3.40	3.60	3.40	3.15
Dec.	3.00	4.65	4.00	4.00	3.60	3.60	3.47	3.40	3.90	3.90	3.70	3.60	3.60	3.40	3.60	3.40	3.13

No. 28 Black Steel Sheets, at Pittsburgh, in Cents per Pound

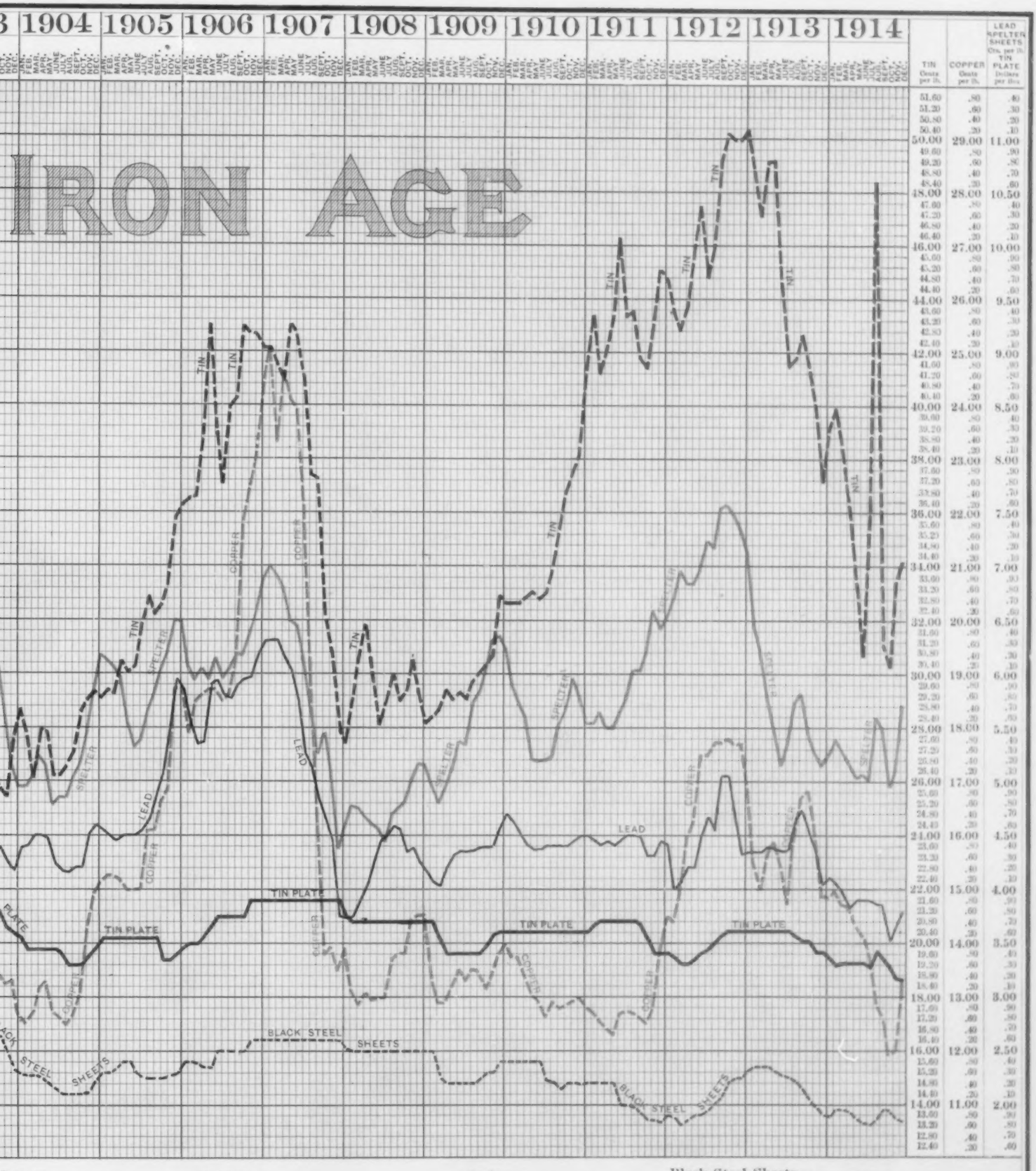
Jan.	2.02½	1.92½	2.97½	2.90	3.07½	2.75	2.29	2.30	2.40	2.60	2.52	2.50	2.40	2.20	1.90	2.31	1.87
Feb.	2.00	2.05	3.03	2.93¾	3.10	2.75	2.27½	2.30	2.40	2.60	2.50	2.50	2.40	2.20	1.87	2.35	1.95
Mar.	1.96	2.36	3.10	3.22½	3.10	2.75	2.27	2.34	2.38	2.60	2.50	2.25	2.40	2.20	1.80	2.35	1.95
April	1.97½	2.60	3.20	3.35	3.12½	2.75	2.25	2.40	2.35	2.60	2.50	2.20	2.40	2.20	1.86	2.35	1.91
May	1.92½	2.78¾	3.20	3.30	3.10	2.75	2.20	2.40	2.35	2.60	2.50	2.20	2.40	2.20	1.90	2.30	1.85
June	1.90	2.93	3.05	3.30	3.05	2.75	2.16	2.30	2.50	2.60	2.50	2.20	2.40	2.00	1.90	2.27	1.81
July	1.90	2.97½	3.14¾	3.10	3.00	2.73¾	2.10	2.26	2.50	2.60	2.50	2.20	2.23¾	2.00	1.95	2.25	1.80
Aug.	1.90	3.08	2.98	3.41	3.05	2.70	2.10	2.26	2.50	2.60	2.50	2.20	2.21	1.99	2.02	2.21	1.86
Sept.	1.96	3.22½	2.93¾	3.77½	2.97½	2.65	2.10	2.25	2.50	2.60	2.50	2.26	2.15	1.91	2.07	2.14	1.95
Oct.	1.92	3.15	2.90	3.23	2.79	2.62	2.10	2.25	2.50	2.60	2.50	2.30	2.20	1.85	2.21	2.04	1.94
Nov.	1.90	3.00	2.89	3.10	2.75	2.49	2.12½	2.27	2.60	2.60	2.50	2.30	2.20	1.85	2.25	1.97	1.87
Dec.	1.90	2.87½	2.96	3.10	2.75	2.32	2.32	2.30	2.60	2.60	2.50	2.40	2.19	1.83¾	2.25	1.89	1.82

LIBRARY
WEST VIRGINIA UNIVERSITY

LEAD SPELTER SHEETS Cts. per lb. TIN PLATE Dollars per Box	COPPER Cents per lb.	TIN Cents per lb.
.40	.80	51.60
.30	.60	51.20
.20	.40	50.80
.10	.20	50.40
11.00	**29.00**	**50.00**
.90	.80	49.60
.80	.60	49.20
.70	.40	48.80
.60	.20	48.40
10.50	**28.00**	**48.00**
.40	.80	47.60
.30	.60	47.20
.20	.40	46.80
.10	.20	46.40
10.00	**27.00**	**46.00**
.90	.80	45.60
.80	.60	45.20
.70	.40	44.80
.60	.20	44.40
9.50	**26.00**	**44.00**
.40	.80	43.60
.30	.60	43.20
.20	.40	42.80
.10	.20	42.40
9.00	**25.00**	**42.00**
.90	.80	41.60
.80	.60	41.20
.70	.40	40.80
.60	.20	40.40
8.50	**24.00**	**40.00**
.40	.80	39.60
.30	.60	39.20
.20	.40	38.80
.10	.20	38.40
8.00	**23.00**	**38.00**
.90	.80	37.60
.80	.60	37.20
.70	.40	36.80
.60	.20	36.40
7.50	**22.00**	**36.00**
.40	.80	35.60
.30	.60	35.20
.20	.40	34.80
.10	.20	34.40
7.00	**21.00**	**34.00**
.90	.80	33.60
.80	.60	33.20
.70	.40	32.80
.60	.20	32.40
6.50	**20.00**	**32.00**
.40	.80	31.60
.30	.60	31.20
.20	.40	30.80
.10	.20	30.40
6.00	**19.00**	**30.00**
.90	.80	29.60
.80	.60	29.20
.70	.40	28.80
.60	.20	28.40
5.50	**18.00**	**28.00**
.40	.80	27.60
.30	.60	27.20
.20	.40	26.80
.10	.20	26.40
5.00	**17.00**	**26.00**
.90	.80	25.60
.80	.60	25.20
.70	.40	24.80
.60	.20	24.40
4.50	**16.00**	**24.00**
.40	.80	23.60
.30	.60	23.20
.20	.40	22.80
.10	.20	22.40
4.00	**15.00**	**22.00**
.90	.80	21.60
.80	.60	21.20
.70	.40	20.80
.60	.20	20.40
3.50	**14.00**	**20.00**
.40	.80	19.60
.30	.60	19.20
.20	.40	18.80
.10	.20	18.40
3.00	**13.00**	**18.00**
.90	.80	17.60
.80	.60	17.20
.70	.40	16.80
.60	.20	16.40
2.50	**12.00**	**16.00**
.40	.80	15.60
.30	.60	15.20
.20	.40	14.80
.10	.20	14.40
2.00	**11.00**	**14.00**
.90	.80	13.60
.80	.60	13.20
.70	.40	12.80
.60	.20	12.40



Fluctuations in Carload Prices of Lake
No. 28 Black Steel Sheets in



ke Copper, Lead, Tin and Spelter in New York and Tin Plate and s in Pittsburgh from January 1, 1898, to January 1, 1915

Cast-Iron Pipe Prices—1901 to 1914

The accompanying diagram shows the course of prices for the past 14 years on 6-in. cast-iron water pipe, f.ob. New York City, in carload lots, per ton of 2000 lb. The table given below is presented for those desiring the data on which the pipe curve is constructed, but going back to 1900. The prices for the first 10 years were furnished by Daniel Runkle, of the Warren Foundry & Machine Company, 11 Broadway, New York, and for the remainder of the period covered were averaged from weekly quotations in *The Iron Age:*

Cast-Iron Pipe Prices at New York, 6-Inch, Per Net Ton

	1900	1901	1902	1903	1904	1905	1906	1907
Jan.	$27.50	$21.75	$24.50	$29.25	$24.50	$28.00	$29.75	$34.25
Feb.	26.75	22.25	25.00	29.25	24.25	28.50	29.50	34.25
Mar.	26.75	21.50	26.25	30.75	24.25	26.75	30.50	34.00
Apr.	26.50	22.00	26.00	31.00	24.25	27.00	29.75	33.50
May	26.00	22.25	27.75	30.75	24.00	27.25	31.00	34.25
June	24.50	23.00	28.00	30.75	23.50	27.25	32.50	33.50
July	24.75	23.75	28.50	30.75	23.50	27.25	30.25	34.00
Aug.	23.50	23.75	29.50	29.50	23.50	27.75	30.50	32.50
Sept.	22.25	23.50	29.50	29.00	23.00	27.25	31.00	33.00
Oct.	21.75	24.00	29.50	26.00	23.25	28.25	33.00	33.50
Nov.	21.75	24.50	30.75	24.50	25.00	29.00	33.25	28.50
Dec.	21.75	23.75	29.25	24.25	27.00	29.25	35.50	28.00

	1908	1909	1910	1911	1912	1913	1914
Jan.	$27.00	$24.50	$25.50	$22.00	$22.00	$25.00	$22.00
Feb.	26.75	24.25	25.50	21.50	22.00	24.75	22.00
Mar.	26.25	25.25	25.50	21.00	22.00	23.87	22.00
Apr.	26.25	25.00	25.50	21.00	21.25	23.50	22.00
May	26.25	25.25	25.50	21.00	21.00	23.00	20.88
June	25.75	26.00	25.25	21.00	21.00	23.00	20.50
July	25.75	26.25	24.00	21.00	22.10	23.00	20.50
Aug.	25.25	26.00	23.50	21.00	22.00	23.00	20.50
Sept.	25.75	25.75	23.50	21.00	23.12	23.00	20.40
Oct.	25.75	25.50	23.00	21.00	24.50	23.00	20.00
Nov.	25.00	25.87	22.12	21.40	24.12	23.00	20.00
Dec.	25.50	25.70	22.00	22.00	24.62	22.33	20.00

To show how closely cast-iron pipe prices follow the fluctuations in pig iron, we have added to the pipe curve another giving the course of prices on gray forge pig iron at Philadelphia and vicinity, as gray forge is largely used in making pipe. The prices on which this curve is constructed, also going back to 1900, have been averaged from weekly prices in *The Iron Age* and are as follows:

Gray Forge Pig Iron, Philadelphia and Vicinity, Gross Ton

	1900	1901	1902	1903	1904	1905	1906	1907
Jan.	$20.37	$14.50	$15.75	$21.75	$13.50	$16.25	$16.75	$23.50
Feb.	20.25	14.50	15.75	21.25	13.50	15.75	17.00	23.50
Mar.	19.25	14.00	17.50	20.00	12.75	16.25	16.75	23.50
Apr.	18.75	14.37	18.25	20.00	13.75	16.25	16.75	23.00
May	18.00	14.37	19.00	19.50	13.75	16.00	16.50	23.25
June	16.50	14.37	19.25	18.25	13.50	15.75	16.25	23.00
July	14.50	14.12	21.75	18.12	13.25	14.50	16.10	22.50
Aug.	14.50	14.00	21.00	15.50	12.50	15.00	16.50	20.25
Sept.	14.00	14.00	21.00	14.75	13.00	15.00	17.75	19.50
Oct.	13.50	14.12	21.00	14.50	12.75	15.75	18.25	18.75
Nov.	14.00	14.37	22.00	14.00	14.00	16.25	20.00	17.00
Dec.	14.50	14.87	22.25	14.00	15.50	16.50	22.00	16.75

	1908	1909	1910	1911	1912	1913	1914
Jan.	$16.50	$16.25	$17.75	$14.25	$14.25	$17.65	$14.00
Feb.	16.50	16.25	17.50	14.25	14.25	17.31	14.00
Mar.	16.50	15.50	16.90	14.60	14.25	16.87	14.00
Apr.	16.00	15.00	16.62	14.75	14.37	16.56	14.00
May	16.00	15.00	16.00	14.70	14.50	15.81	13.81
June	15.25	15.25	15.65	14.50	14.62	15.37	13.75
July	15.25	15.50	15.37	14.50	14.87	14.95	13.75
Aug.	15.25	16.25	15.00	14.30	15.37	14.62	13.75
Sept.	15.50	17.00	14.75	14.45	15.87	14.56	13.75
Oct.	15.50	17.50	14.50	14.25	16.87	15.00	13.62
Nov.	15.75	18.00	14.37	14.25	17.62	14.75	13.50
Dec.	16.00	18.00	14.25	14.25	17.75	14.58	13.50

A. Milne & Co., steel and iron merchants, 741-745 Washington street, New York, whose specialty is Swedish steel and iron, have opened a branch warehouse at 550 Washington boulevard, Chicago, Ill., where they will carry a complete stock of tool steel and hollow and solid drill steel of the well-known FJAB brand.

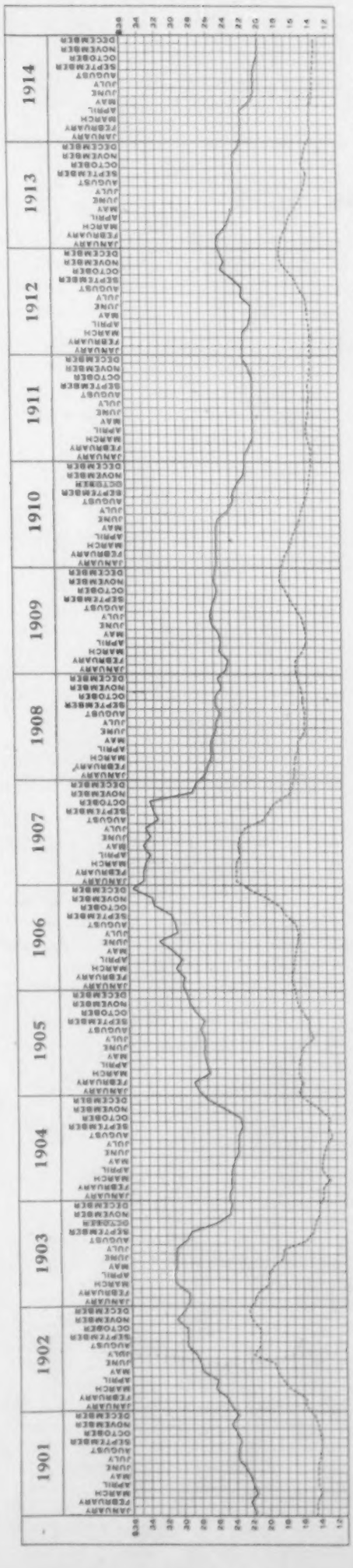


Diagram Showing the Course of Prices of Cast-Iron Water Pipe at New York City for the Past Fourteen Years, Compared with the Course of Prices on Gray Forge Pig Iron at Philadelphia. The Pipe is 6-Inch, Carload Lots, Priced per Ton of 2000 Pounds. The Heavy Black Line Indicates the Pipe Prices and the Dotted Line the Pig-Iron Prices

What of the Federal Trade Commission Act?

Steel Manufacturers Write of Its Possibilities and Emphasize the Need of Some Form of Coöperation

The announcement of President Wilson's appointees to the Federal Trade Commission has been looked for daily since the opening of the new year, and there has been no little public discussion of the kind of men demanded for the work of the commission. That the administration of the act can be made helpful or hurtful to business is well recognized, and in the steel trade there is no small interest in the question of the effect of the new regime. In view of this interest, *The Iron Age* addressed the following letter to a number of iron and steel manufacturers:

Dear Sir:—The newly created Federal Trade Commission has been referred to as standing much in the same relation to the manufacturing corporations as the Interstate Commerce Commission bears to the railroads. Providing for a constant oversight of corporations, it may, if rightly administered, make it possible for manufacturers to act with more freedom in the interest of good business than has been the case in recent years.

We are inviting the opinions of a number of iron and steel manufacturers for "The Iron Age" of January 7, 1915, on the question whether some form of co-operation in their industry is desirable and whether it is made more practicable by the enactment of the trade commission law.

The Foreign Trade Conference has declared for legislation which will permit manufacturers in a given line to co-operate in the export trade, presumably by common representation abroad and through a single export company at home. This proposal is sanctioned also by the National Chamber of Commerce.

It would mean much to the iron and steel industry if the administration of the Federal Trade Commission act should show the way eventually to some form of regulated or co-operative competition—possibly something like the "new competition" of Mr. Eddy, as exemplified in the Bridge Builders' and Structural Society.

We shall greatly appreciate your views at such length as you choose on any phase of the question as suggested above. In view of the disastrous experience of the steel trade in the past 18 months we regard the subject as well worth discussion in a time of such critical interest as the present, when there seems to be a growing appreciation at Washington of the need of a constructive policy for business.

In presenting the replies to the above letter we have put first the one which is plainly receptive to the idea of a closer relationship between business and Government, on the assumption that men of practical experience in business affairs are to represent the Government. Following it is a reply which points out that while no part of existing anti-trust legislation is modified by the new act, there is a suggestion of the route through which practical co-operation among manufacturers eventually may be realized. Then come several expressions which urge the need of some form of co-operation, now that the machinery is provided for Government oversight; and in conclusion is a forceful protest against the further extension of Government by commission, the opinion being expressed that what the steel trade most needs is freedom to work out its own destiny, in view of "the vast change that has come over the spirit of business in this country within the past decade." Each of these communications is thoughtful and thought-provoking.

LET BUSINESS AND GOVERNMENT CO-OPERATE FOR PROSPERITY

JOHN A. TOPPING, CHAIRMAN REPUBLIC IRON & STEEL COMPANY

Your letter requesting my opinion as to the probable influences of the Federal Trade Commission's operations on business is both pertinent and opportune, particularly in the light of the recent decision of another important Federal commission, assuming, as you suggest, that the Federal Trade Commission will have relatively the same influence on business as the Interstate Commerce Commission exerts upon railroad transportation. Viewed from this angle, there is hope for constructive work from the Trade Commission, as the Interstate Commerce Commission has blazed the way under its recent rate decision to confidence in commission regulation, in the precedent established, that the interest of the investing public as well as of the shipping public must be considered. This expression of Government policy should have a very direct bearing on the policy of the Federal Trade Commission, when it is considered that its members too have broader interests to serve than the interest of the consumer and that business prosperity will demand of them a square deal for both capital and labor.

In the fight waged by the railroads for fair play, open debate or public discussion developed not only a favorable public sentiment, but likewise a commission sentiment that recognized the rights of vested interests, and an opposition to the policy heretofore operative that suggested confiscation of property rights. Government by commission, as I view the rate decision, also suggests a precedent for regulated co-operation, the commission admitting, as it does, the right of the owners of property

to a fair profit while maintaining the right of the public to protection against unfair methods or extortion. If the Commerce Commission's broad principle is followed by the Federal Trade Commission, a great opportunity for constructive service is offered, for under the stimulus of co-operation not only will new channels of trade be opened, but old channels will be broadened. Furthermore, with the closer relationship thus promised between business and the Government, a better understanding of the practical business necessities should result from the commission's study of business conditions and thus place the Government in a stronger position to meet new business problems.

To illustrate: It should not be difficult thoroughly to convince the Federal Trade Commission, and through it our Government, that the present restrictions operating against an extension of our export trade should be removed. Neither should it be difficult for the Government to inform itself respecting other practical questions affecting business welfare, such as the modification of laws necessary for the upbuilding and maintenance of a merchant marine, or the modification of laws affecting Patent Office and consular reforms. In my opinion, business only awaits the stimulating influence of a more sympathetic Government policy; and with evidence of such a change of heart in official places, there will be developed on the part of business an active co-operative spirit, without which real prosperity cannot be maintained.

The benefits accruing from co-operative effort have no better illustration than the business spirit back of the Government in its efforts to devise ways and means to overcome the difficulties precipitated by the present European war. Without co-operation between the Government and business there is no question that business would have suffered a much greater disaster than was realized. Therefore, if co-operation between business and the Government is effective to avert disaster, why should there be any hesitancy to employ this influence to promote business prosperity?

It is to be hoped that careful consideration will be given to the question of the fitness of men who may be nominated for membership in the Federal Trade Commission and that appointments will be restricted to men of practical experience in business affairs; for it is realized that unless the commission is wisely selected, constructive benefits cannot be expected or business enterprise and confidence promoted.

CO-OPERATIVE COMPETITION IS DESIRABLE IN FOREIGN TRADE

E. A. S. CLARKE, PRESIDENT LACKAWANNA STEEL COMPANY

It is and always has been my judgment that some reasonable form of co-operation in the steel industry, looking to greater stability and the prevention of the wide and distressing fluctuations in both volume of business and prices that have characterized the business in the past, is most desirable.

You ask whether it is made more practicable by the enactment of the Federal Trade Commission law. Section 11 of that law says that "nothing contained therein shall be construed to prevent or interfere with the enforcement of the provisions of the anti-trust acts nor to alter, modify or repeal anti-trust acts or any part or parts thereof." Therefore, I cannot see how the new act makes such co-operation as I have mentioned directly more practicable. But under section 6 of the act the commission has very broad powers to investigate the conduct of business, and it is required to make annual and special reports to Congress and to submit therewith recommendations for additional legislation. And it might well be that the commission would be convinced, after investigation, that a co-operation such as I have suggested was desirable and would recommend to Congress such legislation as would make it possible.

Under sub-division h of section 6 of the act, the commission has power specifically to investigate such conditions in respect to foreign trade and to report to Congress with recommendations; and I quite agree that it would mean much to the iron and steel industry if the administration of the Federal Trade Commission act should show the way eventually to some form of "co-operative competition." It is particularly desirable in foreign trade, in order that American producers may be on even terms with foreign competitors. But I also deem it of equal value in domestic affairs, in order that fair and reasonable stability of prices and volume of business may be maintained, believing that such a condition would be as much to the advantage of the buyer as to that of the seller. And I venture to express the hope that the members of the commission when appointed will give this situation careful study and attention.

MANUFACTURERS SHOULD BE ALLOWED TO GET TOGETHER

A. F. HUSTON, PRESIDENT LUKENS IRON & STEEL COMPANY, COATESVILLE, PA.

Whether the Federal Trade Commission will prove a benefit to the American manufacturers can only be determined, I think, after its members have been in office for some months, or possibly longer. A great deal will depend upon their disposition in this respect. It may be that they will have a broader view than the general public and some legislators who think it wrong for manufacturers in this country to sell abroad at lower prices than at home when they need to market a surplus product. I think we need to get the idea instilled into them that some kind of a combination is desirable. It was stated by John Hayes Hammond at our meeting of the American Manufacturers Export Association in December that England permits the so-called combinations in restraint of trade, France encourages them and Germany compels manufacturers so to combine.

Steel manufacturers will well remember that a short time ago when the German steel combination at the end of its five years' agreement was about to disrupt, the Emperor personally took a hand in the matter and compelled them to continue. The threatened disruption was because of a new deal being necessary on account of the changed status of certain units. I certainly hope that a moderate amount of combination may be permitted by the new commission. Certain professions are

allowed to have uniform prices and it is usual in country towns to have fixed prices for eggs, butter, etc., while our Government compels the railroads to have fixed prices for freights.

Manufacturers should be allowed to get together and fix upon suitable prices for commodities in different zones, avoiding extremes in both directions; in fact, I believe there should be some way of compelling them to observe certain prices, and anyone who should seek to take an unfair advantage should be penalized.

It would be difficult, and perhaps unprofitable, to go any further than generalities in the above as yet, and inasmuch as we are now forced into keen competition we cannot be much worse off to try this new plan.

CO-OPERATION OF MANUFACTURERS CAN BE OF GREAT BENEFIT

SEVERN P. KER, PRESIDENT SHARON STEEL HOOP COMPANY, SHARON, PA.

Replying to your inquiry in regard to the Trade Commission act: I have had an opportunity to read the bill but once and my impression of it is not good. I very much hope that the practice of the commission when organized will not be harmful. Business has been under such severe attacks for some years past as seriously to affect business administration and in my judgment greatly to minimize successful accomplishments in this country. I am of the opinion that business baiting for the purpose of promoting individual political ambitions is beginning to be somewhat unpopular and I hope it will not be long before the politicians will have to find some other subject on which to appeal to the more or less unthinking part of the voters.

I think that co-operation among manufacturers can be made of great benefit, not only to the industries but to the country at large. I believe it is essential to the best development of industrial enterprises in this country, and if a scheme can be worked out under the Federal Trade Commission that will permit such co-operation it will have accomplished much good which may not be, and we hope will not be, more than offset by hurtful suppressive regulations.

CO-OPERATION MEANS EFFICIENCY AND ELIMINATION OF WASTE

GEORGE M. VERITY, PRESIDENT AMERICAN ROLLING MILL COMPANY, MIDDLETOWN, OHIO

Effective co-operation means elimination of friction and of waste of time and material; in other words, it means that sort of efficiency that is to-day the slogan in all industry. Modern competition results in great and unnecessary waste, and as all waste as well as the result of every other form of destruction must ultimately be borne by the community at large, such methods must be inimical to the interests of society as a whole.

Every commodity or manufactured article must be sold at a price commensurate with its average cost over a period of time. Whenever such forms of co-operation as must result in efficiency and in elimination of the waste incidental to our existing competitive systems can be adopted, we shall have created a condition that will give the individual such commodities as he desires at a sound value. Through lack of some form of effective co-operation between manufacturers and between distributers, many commodities are sold at a loss during periods of depression, with the result that business must earn enough in prosperous times to make up for the losses thus sustained.

Such methods prevent stability and make the average cost of the conduct of business higher than it would be if legitimate co-operation were made possible.

Our modern complex commercial and industrial life has brought innumerable problems that could be solved much more effectively through co-operation, and that can never be satisfactorily or economically settled in any other manner. If any method of practical, effective co-operation that will be fair to both commerce and industry and to the public at large can be outlined, legalized and inaugurated by our new Federal Trade Commission, they will have made a great forward movement in the interest of stabilized national prosperity that will be of the most vital importance to both labor and capital.

THE FEDERAL TRADE COMMISSION LAW WAS A MISTAKE

ALEXANDER GLASS, PRESIDENT PORTSMOUTH STEEL COMPANY, PORTSMOUTH, OHIO

We are sorry that we do not feel qualified to express an opinion on the questions mentioned in your letter. We think that the Federal Trade Commission legislation was a mistake, that will hamper instead of aiding legitimate business and harm instead of benefiting the people of this country; for it must add, as the Interstate Commerce Commission has added, to the cost of doing business and sooner or later in some way or other the people always pay for increased costs.

ORGANIZATION NEEDED TO PREVENT UNFAIR COMPETITION

O. N. HUTCHINSON, PRESIDENT GRAND CROSSING TACK COMPANY, GRAND CROSSING, ILL.

It is an open question in the writer's mind whether the manufacturers of the same or kindred lines of goods will not be forced to form strong organizations in order to enable them to obey the law, to avoid unfair methods of competition, as defined in the Federal Trade Commission bill, and refrain from price discriminations, as defined in the so-called Clayton Anti-Trust bill. But to what end these organizations would finally lead, one man's guess is as good as another's, and all will de-

pend upon how liberal construction the commission gives the laws and also upon their final adjudication by the courts and the amendments that will be made from time to time.

Whether manufacturers will ever be granted the freedom of organization, so that they can agree upon a minimum selling price for their goods, under the control of the commission, time alone will tell. But a strong, enforceable agreement for publicity among themselves in reference to their acts and transactions with the trade seems to be eminently necessary, to conform with the law.

If such organizations could be honestly and efficiently carried on, it would do much to eliminate those things which have led to indiscriminate price cutting and to selling goods at and even below cost, which is an economic waste to any nation and should be as much deplored as unduly high prices which might be traceable to trusts and combinations.

THE CO-OPERATIVE SPIRIT THE GREAT NEED OF BUSINESS

SILAS J. LLEWELLYN, PRESIDENT INTERSTATE IRON & STEEL COMPANY, CHICAGO

"That unfair methods of competition in commerce are hereby declared unlawful."—*Section 5, Act Creating Federal Trade Commission.*

The above is the rule under which we are all now working. Shall we have the disastrous experience of the railroads for the past 15 years in having our business so interfered with and regulated that it shall be on the verge of breaking down, or shall we, by exercising good common sense, solve this question of regulation as applied to commerce and evolve a more thoroughly co-operative system than has as yet been known? The writer hopes that all of our strong business men will devote enough of their time and energy to solving the problem rightly. We need to develop the co-operative spirit.

Is it going to be possible for all of our various lines of industry to get together, to organize, plan and develop this co-operation? I think so, and I believe it to be the duty of every one of us to encourage such development. Whether the plan be that of "co-operative competition," which is brought out very clearly in the Babson publications and has been in practical use in different industries, or whether, with the aid of the Federal Trade Commission, we can organize into various associations that will be regulated by this commission, is not a matter of so great importance as that we develop the co-operative spirit.

Without such cooperation we shall have a sorry time and a gradual breaking down of the best commercial development this country has yet seen. With it there is nothing too great for successful execution.

THE COUNTRY'S STEEL BUSINESS NEEDS TO BE LET ALONE

JOSEPH G. BUTLER, JR., VICE-PRESIDENT BRIER HILL STEEL COMPANY, YOUNGSTOWN, OHIO

I am in receipt of your letter in which you ask for my opinion as to the probable effect of the newly created Federal Trade Commission. In response I have this to say:

Deplorable as has been the condition of the steel and iron industries, it will probably be only made worse by empowering any commission to interfere with its management. Such commissions, usually created and given authority in the hope that they may prove constructive, have uniformly proved exactly the opposite. The Interstate Commerce Commission, in conjunction with numerous State commissions empowered to regulate railroad management, has given an excellent example of the result of efforts to supplant the laws of competition with Governmental regulation.

Few steel manufacturers desire to see the steel industry reduced to the condition of the transportation industry. It is hard enough to make ends meet, without having them stretched still further apart by increased expenditures and diminished revenues. Bad as the steel business has been, it has not had to submit to the fixing of its costs as well as its revenues by a commission only superficially acquainted with either and apparently not all informed upon the relation between the two. We already feel severely enough the pressure of laws forbidding even a friendly understanding among men engaged in a business so vast and complex that it cannot be successfully conducted otherwise. The addition of a second Interstate Commerce Commission to our troubles would not, in my opinion, add to our comfort, our revenues, or the service which manufacturers can now render to the public.

We already have too many commissions. There is too much paternalism at Washington. What the steel business of the country needs is to be let alone and given an opportunity. In this direction we have enormous need of an American merchant marine; but that now being formed by the Government is certain to be a failure because it is being formed on an entirely false foundation. With a merchant marine growing out of genuine needs and opportunities for profitable investment in ships, we would now be in a position to secure large additions to our markets. But the efforts of the Government, while doubtless well meant and sincere, are almost certain to be abortive.

From the broad viewpoint that recognizes the sound basis of prosperity in the iron and steel business to be capable management and freedom of operation, the proposition to have it managed from Washington is not encouraging, to say the least. More than 50 years spent in the manufacture of iron and steel have taught me that to have this great industry subjected to the domination of theorists, and the practical knowledge and energy that have builded it to its present stage throttled by additional regulation, would be little short of a calamity.

A vast change has come over the spirit of business in this country within the past decade. If left to enjoy the fruits of its own energy, without the checks and obstructions inseparable from even partial Governmental regulation, it can be depended upon to recognize its obligations to the people and to serve them faithfully while making full use of its opportunities for constructive development and growth.

New Iron and Steel Works Construction

Open-Hearth Steel Capacity Now Building, 1,750,000 Tons a Year—That Completed Last Year Represented 1,215,000 Tons

In new work initiated in the year, representing additions to blast furnace or steel making capacity, 1914 has the meagerest record for more than 20 years. Only three new blast furnaces were projected last year—two by Corrigan, McKinney & Co., at Cleveland, and one by the Pennsylvania Steel Company, at Steelton. Work on the latter and on one of the former is now in progress. The capacity of the three will be about 500,000 tons a year. Blown in in the year was new furnace A of the Bethlehem Steel Company, with a capacity of 150,000 tons a year. The rebuilding of furnace C of the same company was completed last year, but conditions have been such that it was not needed. Still counted as under construction are the two furnaces of the Minnesota Steel Company at Morgan Park, Duluth, which are rated at 280,000 tons a year.

One year ago a remarkable showing was made of open-hearth steel capacity added in the previous twelvemonth and of open-hearth furnaces under construction. A total of 51 such furnaces had been completed in 1913, with an annual capacity of 2,920,000 tons, while on January 1, 1914, the number of open-hearth furnaces under construction was 46, with annual capacity of 2,530,000 tons. One year ago we reckoned seven of the 14 open-hearth furnaces the Carnegie Steel Company had been building at Edgar Thomson as having been added to the country's capacity, while the other seven, though practically completed, had not been operated, and were therefore carried over to the reckoning for 1914. Besides these there have been added in 1914 to the country's capacity the following: Two 200-ton tilting furnaces and one 75-ton stationary furnace of the Pennsylvania Steel Company; three 50-ton furnaces of the Colorado Fuel & Iron Company; two 75-ton furnaces of the Kokomo Steel & Wire Company; one 80-ton furnace of the West Penn Steel Company, Brackenridge, Pa., and one 40-ton furnace of the West Leechburg Steel Company, Leechburg, Pa., replacing a 20-ton furnace. The total additions of the year are therefore summarized as follows:

New Open-Hearth Furnaces Built in 1913

	No. furnaces	Annual capacity, gross tons
Independent companies	10	795,000
United States Steel Corporation	7	420,000
Total	17	1,215,000

Of furnaces under construction the Steel Corporation is still to be credited with 10 at the plant of the Minnesota Steel Company, which have figured in the new construction statistics of the past four years. Work the independent steel companies now have under way includes three 60-ton furnaces of the Youngstown Iron & Steel Company, Youngstown, Ohio; four 60-ton furnaces of the Lackawanna Steel Company, Buffalo, N. Y.; six 60-ton furnaces of the Bethlehem Steel Company, South Bethlehem, Pa.; eight 75-ton furnaces of Corrigan, McKinney & Co., Cleveland, Ohio; three 60-ton furnaces of the Central Steel Company, Massillon, Ohio; one 50-ton furnace of the Lukens Iron & Steel Company, Coatesville, Pa.; four 50-ton furnaces of the American Iron & Steel Mfg. Company, Lebanon, Pa.; two 60-ton furnaces of the Leetonia Steel Company, Leetonia, Ohio, and one 25-ton furnace of the N. & G. Taylor Company, Cumberland, Md. The oncoming capacity thus stands as follows:

New Open-Hearth Furnaces Under Construction

	No. furnaces	Annual capacity, gross tons
Independent companies	32	1,250,000
United States Steel Corporation	10	500,000
Total	42	1,750,000

It thus appears that in a year in many respects the most discouraging and calamitous the steel trade has known, the amount of new open-hearth capacity actually added or that was under construction represented a grand total of nearly 3,000,000 tons.

Jones & Laughlin Steel Company

The new construction work of the Jones & Laughlin Steel Company, Pittsburgh, in 1914 was very much less than in preceding years. Two new stoves were added to the Soho furnace at Pittsburgh, and the other stove was relined and minor improvements made which will increase the capacity of the furnace from 350 to 400 tons of pig iron per day. This furnace was blown out on December 6, 1913, and is still idle.

Eight more hot tin mills were built at the Aliquippa works, giving a total of 32. These were built in the foundry and machine shops of the company and in record time, the entire eight mills having been completed and installed in about 45 days. Foundations had been provided when the tin mill was erected.

The company also built two new steel barges for handling coal from the Vesta Coal Company, an identified interest near Brownsville, Pa., to the South Side and Aliquippa works. This gives a total of 24 200-ft. steel barges owned by this company, each having a carrying capacity of about 1000 tons. The company also added a new steamboat for towing barges.

Otis Steel Company

The Otis Steel Company, Cleveland, placed in operation in the latter part of the summer the first unit of its new Riverside Works for the manufacture of all grades of light plates, from ¼ in. thick down to and including No. 18 gauge. The new works include a complete jobbing mill plant, several stands of cold rolls, a 72-in. plate mill and all equipment necessary to produce common red plates, blue and box annealed sheets, pickled, and one and two pass cold rolled and patent, leveled finished sheets in all gauges.

Crucible Steel Company of America

At all plants a general conservation of quick-moving supplies to mills, furnaces, shops and other departments, with a corresponding saving of time required for handling, has been effected through a careful survey of efficiency matters, followed up quietly but with energy and system. The safety and welfare work in all departments has been advanced and will show still greater results in the coming year. In the Pittsburgh district particularly a marked effort has been made, as in preceding year, to improve the boiler and heating furnace conditions and to eliminate what remains of objectionable smoke.

Crescent Works: A main coal handling plant has been installed to handle coal by rail and river. A new shop building to contain all shops of the plant, is nearing completion. It is of brick and steel and will be fitted with modern equipment.

Park Works: Heating furnaces in the blooming mill are being equipped with furnace stokers to increase efficiency and to eliminate smoke. Improved machinery for cutting off and handling tool steel bars has been put in; the fire protection system has been improved and extended and a new water tower erected.

La Belle Works: A new boiler house with modern equipment and facilities for handling coal and ashes has been put in service; new machinery installed for cutting off bars, etc., and the heat-treating department enlarged and improved. The 10-ton overhead electric crane installed last year has been of service in greatly reducing yard costs.

Singer-Nimick Works: Installation of stokers and other improvements of boiler stations under consideration.

Spring Works, McKees Rocks: Improvement of water supply and also of heating furnaces now under way.

Atha Works, Harrison, N. J.: Now erecting a new 20-in. motor-driven cogging mill to break down 4 x 4-in. billets.

Spaulding-Jennings Works Jersey City, N. J.: Boilers have been equipped with modern stokers and other improvements made in the power house; cold rolling and drawing departments equipped with motor drive, replacing old steam engines; annealing department improved and enlarged.

Syracuse Crucible Steel Company, Syracuse, N. Y.: This plant, which will incorporate the most modern features for the manufacture of high grade crucible tool steels is now in the hands of the company's engineers at Pittsburgh, who are making plans for installation of the latest type of mills and equipment to be erected in 1915. Electricity will be used for all purposes except heating. It is expected that active work will be started early in 1915.

Halcomb Steel Company, Syracuse, N. Y.: A new gas producer installation is being developed by tests and experiments, and if it works out as expected it will effect great savings in fuel and general operation.

Crucible Fuel Company: This concern has been extending and improving its mining properties and introducing modern equipment. By installing a number of steel barges it has materially improved its river transportation facilities.

Pittsburgh Crucible Steel Company

At Midland, Pa., this company has completed the building of a Morgan continuous merchant bar mill of modern design. Under way is a large reversing bar mill to be completed about March 1, 1915, also a plow mill by June 1, 1915, and coulter and disc shop by August 1, 1915. The Pennsylvania Railroad Company has recently acquired a large area of land adjacent to the plant of the Pittsburgh Crucible Steel Company and is now constructing a new yard to handle the shipments of the steel company to better advantage. This takes in over 20 acres, with its approach, and will be finished by March 1, 1915. Connecting the steel plant with the town of Midland will be two large concrete subways, now under construction and expected to be finished about the same time as the railroad yards.

Lukens Iron & Steel Company

The Lukens Iron & Steel Company, Coatesville, Pa., added one 50-ton open-hearth furnace to its steel plant last year. It is now installing transfer tables (cooling bed) for its 84-in. mill, which will put it in position to furnish plates more nearly flat than in the past. It has completed and put in use a new fireproof storehouse for general supplies, also a central water pumping station. It has finished its own ice plant and is now in position to furnish cool water to all its men. All the open-hearth furnaces have been equipped with water cooling devices to reduce the heat for the men working at the furnaces.

Republic Iron & Steel Company

New construction work of the Republic Iron & Steel Company in 1914 was much lighter than usual, being chiefly the erection of 68 by-product coke ovens of the Koppers type, to supply coke for the three blast furnaces at Haselton, Ohio. In the Southern district it completed the rebuilding and remodeling of its No. 1 blast furnace at Thomas, Ala., which is ready for operation as soon as business conditions warrant.

Bethlehem Steel Company

In the first seven months of 1914 a great deal of construction work was in progress at the two plants of the Bethlehem Steel Company, but about August 1 construction was entirely suspended on account of existing commercial conditions and has not as yet been resumed.

LEHIGH PLANT

Blast Furnace C, which was dismantled, has been rebuilt along modern lines, provided with electric skip, and other mechanical equipment. Its product has not yet been needed and the furnace therefore has not been put into service.

ROLLING MILLS

Work is practically completed on the 35-in. reversing blooming mill, which is driven by reversing motor generator set, also on the soaking pits, gas producers, stripper, etc. The 18-in. Morgan continuous mill, four-stand 22-in. round mill, and 16-in. and 12-in. mill, 12-in. and 8-in. combination mill, and the 10-in. guide mill, are all set up in place, practically ready to operate. The motors for these mills have all been received and are partly wired. The buildings, crane-runs and cranes have been completed, and generally the layout is nearly ready to put into operation. Similarly the treatment department for alloy bars, and the finishing end, which includes straighteners and cold drawing equipment, was also well under way when work was suspended. These mills and their buildings and auxiliary equipment will be of the highest type throughout. The buildings are all of brick, with steel sash, concrete roofs, and will have brick pavements throughout. Everything is driven electrically, there being no steam or hydraulic equipment in this department.

The mills themselves are of heavy construction and especially designed in all cases for the alloy steel bars which they are to roll. Throughout the entire mill plant no wood is used for any purpose.

Plans are fully developed and some work done on rebuilding the puddle mill and its building, these plans including the replacing of the steam engines with electric motors. Similarly in the crucible department plans are all completed and some material on the ground for a new 16-in. and 12-in. and a new 12-in. and 8-in. mill for handling crucible products. These mills are also motor driven and will be suitably equipped with heating furnaces and annealing furnaces for this high grade crucible steel.

Equipment has also been purchased for the crucible department for drawing high speed drill rods, and this equipment will be put into service in the next few months.

OPEN-HEARTH FURNACES

The six open-hearth furnaces which were begun last year to furnish additional steel for the above mills were well under way when the suspension was ordered. The building is completed and foundations are in and part of the brickwork installed.

The 10-ton Girod electric furnace is completely installed and practically ready to operate.

The buildings over these furnaces are similar to the mill buildings, constructed of brick, steel sash, etc. The open-hearth furnaces are to be heated with producer gas from Hughes producers, two producers to be provided for each furnace.

ELECTRIC POWER HOUSE AND OTHER BUILDINGS

The building for the extension to the power house has been completed and the crane is in operation. Three of the 3000-kw a.c. generators which are to be driven by Bethlehem gas engines are practically installed, and the foundations for a fourth unit have been completed. The 1200-kw motor generator balancing set has been put into operation and is operating satisfactorily between the a.c. and d.c. systems.

About the middle of the year the new chemical and physical laboratory was occupied, an illustrated description of which was given in *The Iron Age* of September 24, 1914. This is a modern laboratory in every sense—in the character of the building and its equipment. The two old stone laboratories, physical and chemical, have been torn down to make room for the gas house for the new open hearth.

A contract has been let for a new safety and welfare building, to be erected near the main gate. It will be completely equipped for first aid work, in addition to providing quarters for the safety and welfare department.

In the yard department one 60-ton and two 30-ton locomotive cranes have been added to the equipment, and put into service during the year. The two 30-ton cranes are equipped with electric magnets.

The brass foundry has been extended to provide approximately twice as much floor space, and is also much more conveniently arranged for cleaning and shipping castings.

In the drop forge department work is progressing on a new system of blowers and oil and blast piping for the heating furnaces, which will be more efficient than the present system. A number of machine tools have also been added to the equipment of this department.

ORDNANCE DEPARTMENTS

To the departments devoted to the manufacture of ordnance extensions and additions have been made or are in progress of construction as follows:

Two additional stories have been added to the projectile machine shop, and additional machine tools installed. A number of hydraulic presses and additional treating equipment have also been provided.

In No. 4 machine shop, which is used for the manufacture of small guns and field carriages and other field equipment, stories are being added and other additions made which will result in a considerable increase in floor space. Additional machine tool equipment has also been provided.

In the treatment departments of the plant a number of furnaces have been added, considerably increasing their output.

In order to supplement and round out the ordnance products of the company, a fuse plant is being erected at Redington, five miles distant, and is practically completed.

Similarly a powder plant has been authorized to be located at New Castle, Del., and a cartridge case plant at Bethlehem. The plans are well under way for these two departments and the plants themselves will be pushed to completion.

The proving grounds at Redington, which are used for the proving of all guns up to 14 in., have been entirely rebuilt, new foundations and tracks installed, and a new 125-ton electric crane installed for handling the guns and mounts from the cars to their firing positions. This puts the proving grounds in excellent condition for proof-firing guns of all sizes.

SAUCON PLANT

The addition to the pumping station has been completed, and the 20,000,000-gal. motor-driven centrifugal pump put into operation.

At the entrance to this plant a new watchman's building, pay office, iron gate, etc., are authorized and work is in progress.

A number of waste heat boilers have been installed at the open-hearth plant and also over the heating furnaces at the 28-in. structural mill, and more are being erected.

An additional heating furnace for the 28-in. structural mill is just about completed.

Corrigan, McKinney & Co.

Corrigan, McKinney & Co., Cleveland, Ohio, have nearly completed their new steel plant, the erection of which was started late in 1913, and have begun the erection of the first of two new blast furnaces, contracts for which were let in the past year. Work is not being pushed rapidly on the steel plant, owing to present industrial conditions, but the buildings are finished and the equipment is now being installed, and it is expected that it will be ready for operation next summer. The firm announces that it is planning no further building work this year beyond that under way. Its original plans included the building of a finishing department, including a rail and structural mill and four merchant mills after the erection of the open-hearth plant. The steel plant comprises eight 75-ton open-hearth furnaces; a 40-in. blooming mill built by the United Engineering & Foundry Company, and driven by a 46 x 60 x 76 in. twin tandem, compound condensing, reversing engine, furnished by the Mesta Machine Company; a 21-in. and 18-in. continuous sheet, bar and billet mill, with complete equipment, including shears, tables, hot beds, etc., built by the Morgan Construction Company; a 1000-ton hot metal mixer furnished by the Pennsylvania Engineering Works, and 23 Hughes gas producers built by the Wellman-Seaver-Morgan Company. The crane equipment is being furnished by the Morgan Engineering Company. The contract for two 22 x 90 ft. blast furnaces has been awarded to the Variety Iron & Steel Works Company, Cleveland, which is now working on the foundations for the stoves for one of the furnaces. The second stack will not be started until the first is completed. Contracts have just been placed with the Mesta Machine Company for three horizontal cross compound blowing engines for the blast furnaces, and with the United Engineering & Foundry Company for 100 charging box buggies and ingot mold cars. A contract for ore and coke bins is pending.

Lackawanna Steel Company

At Lackawanna, N. Y., the company last year added two turbo centrifugal hydraulic pumps and a compound duplex hydraulic pump in connection with the No. 1 open-hearth plant. Six waste heat boilers equipped with superheaters are being installed in connection with the new furnaces at No. 2 open-hearth plant. The construction of furnaces Nos. 17 to 20 inclusive at this plant was continued during the year and the extension to the building for four additional furnaces has been erected.

An extension to the No. 1 mill was made and an additional four-hole pit furnace installed, together with necessary extension to producer plant. A deseaming machine has been provided in rail mill No. 1 for deseaming the surface of rails. An additional four-hole pit furnace was built at No. 7 mill, together with extension to furnace building and producer plant. An ad-

(*Continued on Page* 100)

The Making of Men, Motor Cars and Profits

What a Year of Profit Sharing at Plant of the Ford Motor Company Has Brought Out

The Large Part in Human Salvage Taken by the Sociological Department

A Decrease of Nearly 90 Per Cent. in Discharges and 97 Per Cent. Less Rovers

One-Fourth the Number of Absences; Large Increases in Bank Deposits and Home Purchases

A School in the Art and Science of Living; Shop Foremen Voluntarily Direct Classes in English

Daily Production Increased 15 Per Cent. with 2000 Less Employees

Remarkable Additions of Special Machinery and Developments in Manufacturing Processes, Not to Mention a 75 Per Cent. Increase in Assets

BY O. J. ABELL

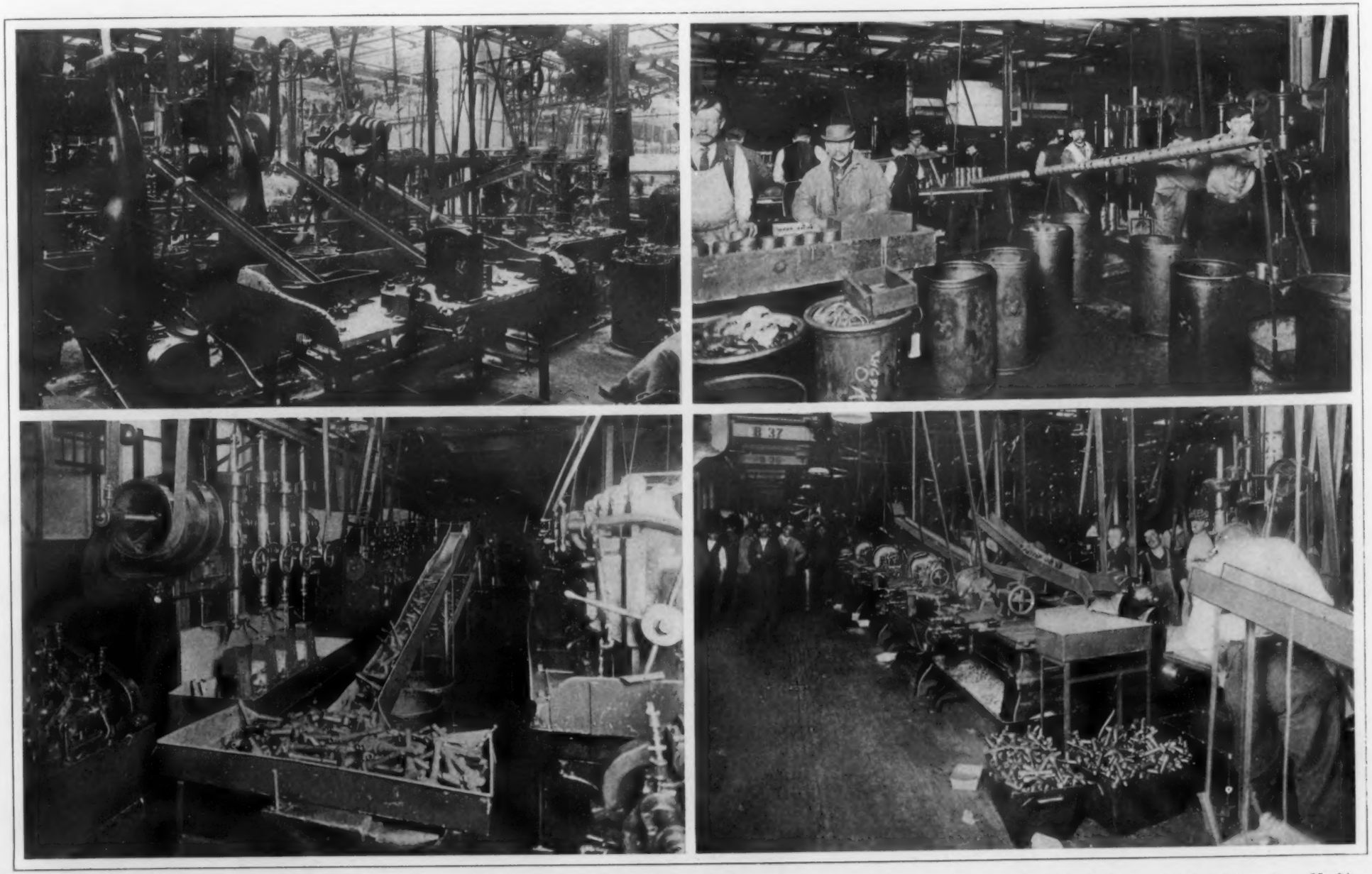
This is, in a way, a sequel. It is also historical. A year has passed since the Ford Motor Company began the administration of its unorthodox and unprecedented plan of sharing profits with its employees. At the time of its announcement, a year ago, a full statement of the plan and its purpose was made in these columns. It need hardly be recalled with what haste and unanimity manufacturers in general heaped adverse criticism upon this company and its plan, some with sincerity, others with scorn and derision. It may be thought that what is here set down is written in vindication of those proposals, which, undertaken without previous experience, have established themselves as a fixed policy. Such is not the purpose. The material gains which have accrued to the Ford Motor Company are in every way such as to utterly dwarf the question of vindication, for these gains, if not altogether attributable to the new employee policy, were at least coincident with its enforcement. Such value as there may be in this recital of what has been accomplished can be indicated in no better way than by quoting from a letter written April 13, 1914, by Henry Ford to an organization at Cleveland to which he had been asked to speak concerning the Ford plan. He wrote:

> I am very glad to know that you are interested in our earnest, thoughtful endeavor to make the most of the human element in manufacturing from a mutual standpoint.
>
> *We have neither the time nor the inclination to exploit this policy and purpose as a general entertainment* and we do not seek any advertising of it on a purely selfish basis. If you have in Cleveland employers of labor who are interested along the same lines that we are, I shall be very glad to let my representative go to you with our simple story that it may be of individual benefit and result in some general good for your community.

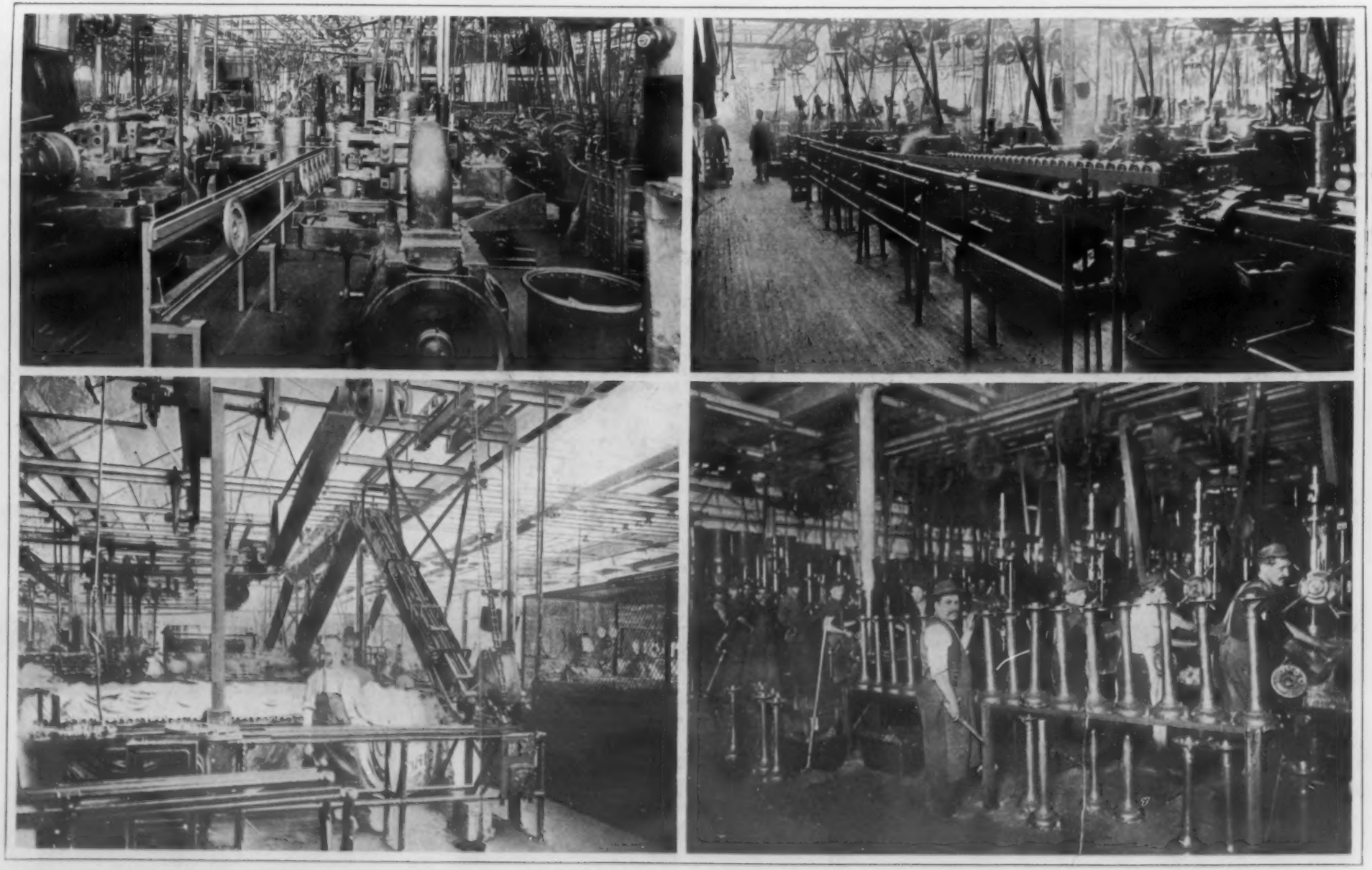
If it were the fact that the Ford Motor Company presents a condition and an experience entirely impossible of application to other industrial enterprises, there would be little reason for this article. But it is the writer's belief that in many of its methods the company has blazed trails of great promise, which may be followed by a good many other employers to their substantial profit.

Conditions in industry could hardly have provided a more severe test for profit sharing plans than they have undergone the past year. Distributions to employees have been suspended by some of those organizations commonly accepted as the lead-

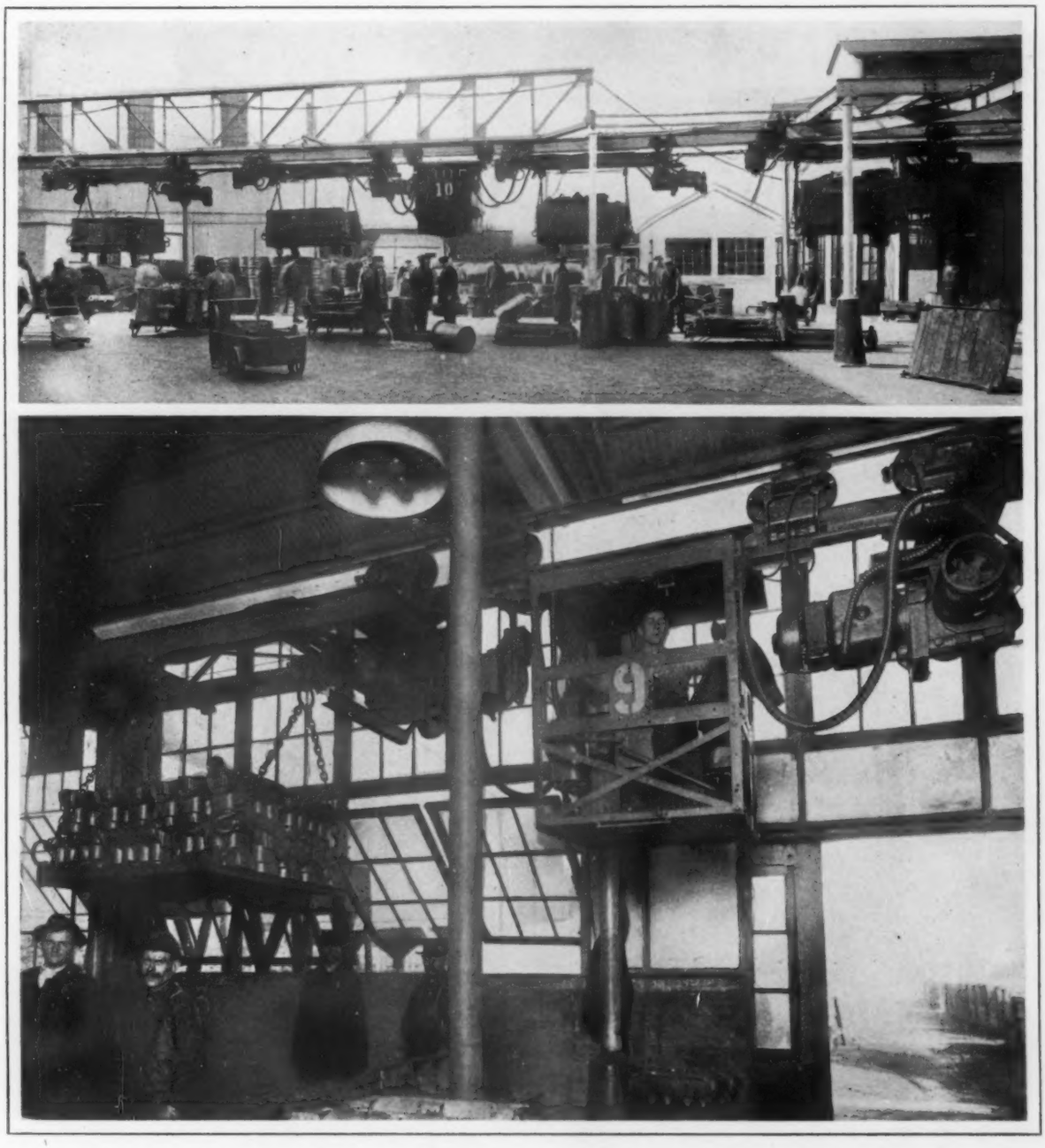
The New Design of the Later Ford Buildings. The Crane, the Landing Platforms at Each Floor and the Cars Below Tell Their Own Story of the Ease and Dispatch With Which Materials are Moved from and to the Floors on Either Side of the Craneway



One of the Most Important Devices for Increasing Production Devised in the Past Year Has Been in Connection with the Gravity Transfer of Materials in Process of Manufacture from Machine to Machine. Four Examples Are Here Shown



The Upper Left-hand Illustration Shows a Simple Runway on Which Flywheels Pass by Gravity from One Operation to the Next. The Upper Right Hand Shows a Carrier from Finishing Operation on Gear Blank to First Operation on Gear Cutter. The Lower Left-hand View is of a Carrier for Transferring Partly Assembled Magnetos from One Punch to Another at Some Distance. The Lower Right-hand View Shows a Slide for the Rear Axle Transmission Between Two Drilling Operations.



Transfer Trolleys Operate in Trains Between the Foundry, the Heat Treating Plant and the Machine Shop. At the Top Is a Typical Trolley Train and the Effective Manner in Which a Load of Cylinders Is Piled for Transfer Is Shown Below

Balance Sheets of the Ford Motor Company

	September 30, 1913	September 30, 1914
Assets		
Cash on hand and in banks	$13,225,710.82	$27,441,468.79
Michigan municipal tax-exempt bonds at cost	1,283,943.59	
Michigan municipal bonds at cost		1,330,546.84
Accounts receivable	448,233.93	3,233,582.73
Merchandise inventory at cost	9,046,171.68	9,284,449.26
Other investments	7,433.32	
Outside investments		9,200.00
Prepaid expenses	215,259.29	437,089.77
Real estate	1,540,483.42	2,227,567.88
Building and building fixtures	4,615,156.82	
Buildings and building fixtures		10,714,928.45
Factory equipment	676,589.49	1,661,155.23
Office furniture and fixtures	77,357.60	
Furniture and fixtures		105,263.95
Power plant	526,945.24	
Machinery and power plant		3,821,465.38
Machinery	2,305,962.09	
Tools	824,901.04	1,199,779.11
Patterns	92,710.13	105,992.30
Machinery, tools and equipment at branches	89,837.13	
Patents	57,224.27	59,767.47
	$35,033,919.86	$61,632,257.16
Liabilities		
Accounts payable	$3,049,586.86	
Accounts payable, not due		$3,335,139.01
Accrued pay rolls	191,940.70	537,489.70
Accrued salaries	24,169.30	44,229.95
Accrued expenses	266,119.43	218,140.50
Contract rebates	25,960.00	621,381.12
Reserve for employees' bonus	134,999.96	
Reserve for bad debts	3,510.55	
Reserve buyers' profit-sharing		2,557,080.00
Reserve for depreciation of fixed assets	1,061,805.25	1,935,440.07
Reserve for depreciation of patents	57,224.27	59,767.47
Reserve for fire insurance premiums	34,059.63	
Fire insurance reserve		43,934.45
Reserve for unearned profits (branches)	60,370.23	
Surplus		48,827,032.07
Capital stock	2,000,000.00	2,000,000.00
Surplus	28,124,173.68	
	$35,033,919.86	$61,632,257.16

ers in successful management. By way of contrast the comparative financial statement of the Ford Motor Company as of September 30, 1913, and of September 30, 1914, is a strikingly interesting and significant document. It is reprinted here and attention is called to the remarkable increases in cash and every other "assets" item. It is to be noted that over one-half of the total assets of the company exist in the form of cash or the most liquid of securities. The manner in which reserves are accumulated or set aside against the maturity of obligations may also be pointed to with emphasis.

Directly coupled with the above financial statement is the record of what has been accomplished in production. In the past year the Ford Company has added to its own factory operations all of the machine work formerly conducted by Dodge Brothers, the work of a large plant in itself; it has assumed the manufacture of several additional parts of its car, formerly purchased; it has shortened the hours of labor from 9 to 8; it has increased the daily production of cars fully 15 per cent., and at the same time the number of employees is less by nearly 2000. Further than this it may safely be said that an additional thousand employees could be dispensed with tomorrow without affecting the production by as much as a single car.

But now this company seldom discharges an employee. Those who leave do so of their own volition. The man is hopeless indeed who is finally discharged. Every possible effort to fit him into a place where he can take root must previously have failed. Correspondingly few men are hired. The employment office is continuously deserted. What is the result? In March, 1914, the number of men discharged was 166 as compared with 1276 in March of the year previous, a decrease of 86 per cent. In the same month of 1914 the number of men who quit showed a decrease of 87 per cent. as compared with the year previous. In one month in 1914 the number of "floaters" was 97 per cent. less than in the same month the previous year. This does not mean that there are not still employees who get drunk, are lazy or incompetent. There are occasional cases of the former and more of the latter, but these offences are no longer considered as occasions for discharging the men; on the contrary, they indicate a need for getting a new hold on the employee and a need for giving him some new help. This help is not likely to be of the parlor variety. The dirtiest, meanest job in the foundry is the probable lot of the man who has been too lazy to do a day's work at an easier task. The discipline is not vindictive, but carefully chosen for its probable effect. If one influence or form of pressure is not effective in bringing results, some other is tried.

Modified Cyanide Preheating and Hardening Furnace for Gears

An Ingenious Machine for the Rough Finishing of Cams on the Cam Shaft. There Are 8 Tool Holders, One for Each Cam. The Shaper Action is a Rapidly Reciprocated Motion Horizontally, While Simultaneously a Vertical Adjustment is Provided Accommodating the Cutting Tool to the Cam Contour. The Shaft is Chucked Horizontally as Indicated in the Illustration

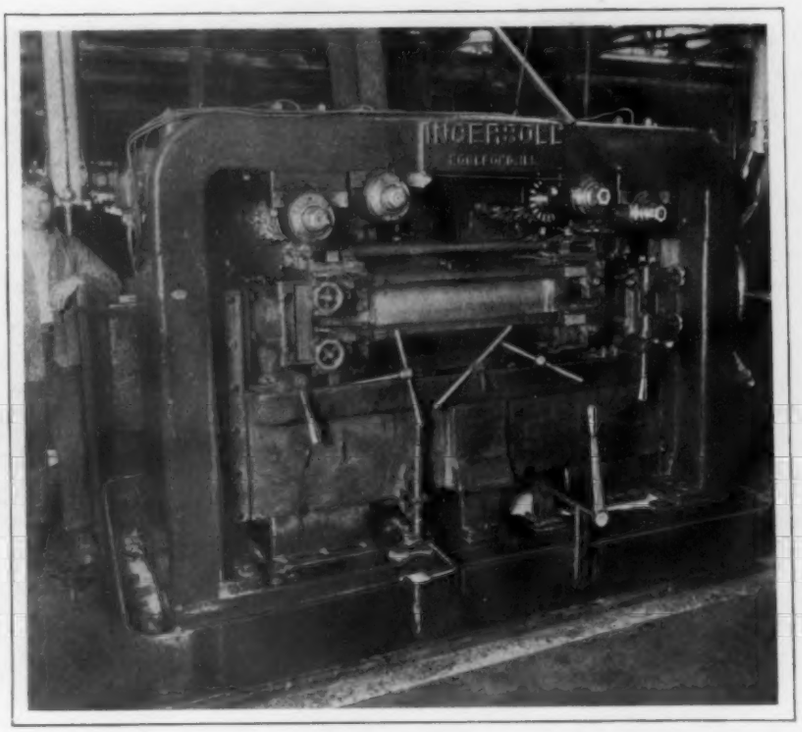
The Ford Motor Company charges itself with the responsibility of bringing to its employees a sense of their own obligation to themselves and to the community and it does not cease its efforts so long as the individual remains within the company's sphere of influence. If an employee fails to appear for work one day, an investigator from the company is specifically dispatched to look that man up not later than the next day, and whatever may be the explanation of the man's absence the necessary steps are taken to get him back to work as soon as possible. One result of this immediate investigation of absences is shown in the following figures:

Date	Men on roll	Absent: sick, etc.	Per cent.
Oct. 6, 1913	12,548	1250 (estimate very low)	10
Oct. 6, 1914	12,645	311	2½

When the first survey was made, under the profit sharing plan, of the records of all the employees it was discovered by the corps of investigators that approximately 60 per cent. of the men came up to the requirements demanded and were eligible to participation in the profits on the basis of the $5, $6 and $7 minimum schedule per day. During the course of the year the company has by reason of its corrective influence brought the number of those eligible up to 84 per cent. This 84

per cent. is now actually receiving its daily share in the profits. In addition to requiring new employees to meet the required standards, they must have been in the employ of the company for six months before becoming eligible to participate in the profits. This is essentially a period of probation.

The mere statement that the number of employees sharing in the profits has been increased 24 per cent. does not begin to indicate the tremendous humanitarian effort that has been expended voluntarily in the rehabilitation of men. This 24 per cent. is human salvage and the same kind of work is steadily going on to hold that 24 per cent. up to their new standard and to bring the remaining 16 per cent. to the same level.



An Ingersoll Milling Machine of Novel Design Providing for Continuous Milling of Both Ends of the Front Axle Simultaneously and Accommodating 8 Axles at a Time

Nor has this reconstruction of the incompetents, the incorrigibles and the vicious been done with any pampering or wasted sentimentality. It is an intense, vigorous, practical proposition. Here men who never before in their lives have had an uplifting impulse are literally being compelled to work out their salvation. A typical instance is recited by the head of the sociological department. A strapping six-footer walked into his office.

"I want to know why I don't get $6 a day," said the workman. The man's record was looked up.

"You don't get $6 a day," he replied, "because you couldn't use it. You don't know how. For example, you pay your board two weeks in advance; you stick the rest in your pocket. It goes gradually for one thing or another; you don't know what. By next payday you haven't a cent. You have a good time, or think you do, and just drift along. When you can show us that you are thrifty we will gladly help you."

"I have been a bum once," the man muttered, "and I guess I can be a bum again."

"You certainly can," replied the chief. "But don't be a fool."

The man was questioned, and it was learned that he had a mother, whom he had not seen or written to in five years. He owed money, but he calmly remarked that his creditors did not expect to be paid.

He was told to go out, see what he could do and return in six weeks. In six weeks he came back. He was fairly well dressed.

"Come in and let me look you over," said the smiling chief.

He came in, put his hand in his pocket and drew out a letter.

"Have a look," he remarked.

The letter was from his mother. It was full of surprise and gratitude. She had been drifting hither and yon, the unwelcome guest of relatives, and at the time she received his letter she did not quite know what she was to do next. He had sent her $25, and it was a godsend.

Then he pulled out a receipt from some lodge he belonged to, acknowledging five years' back dues. He pulled out a bill from a tailor. It was for $60 and he had paid $11 on it. Last of all, he pulled out a bank book, showing $14 to his credit. And all that had been done in six weeks, without a cent of profit-sharing.

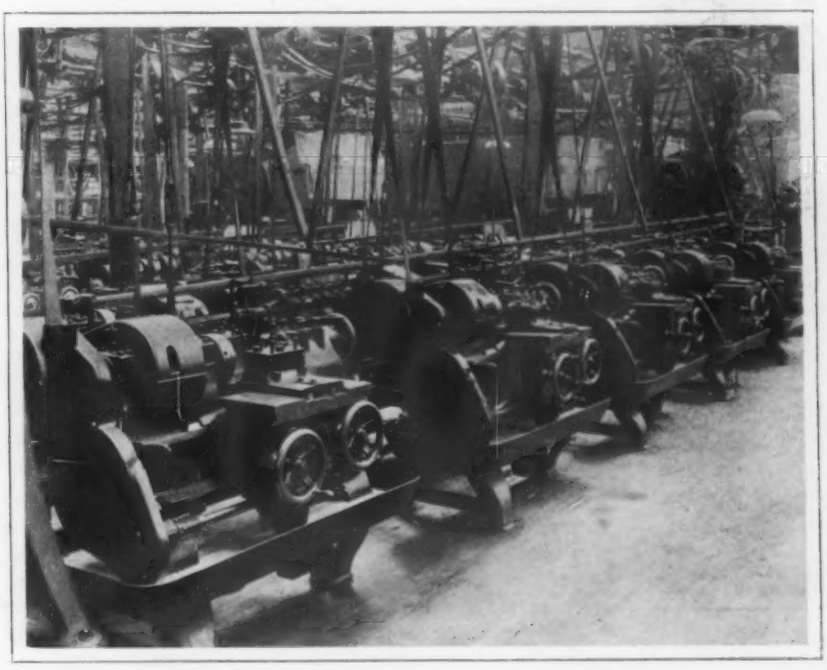
"Well, you have done pretty well, Bill," said the chief. "Hold on a while and come in again."

"For heaven's sake, how long have I got to hold on?" asked the workman.

"Until it doesn't hurt you. Then we will let you off."

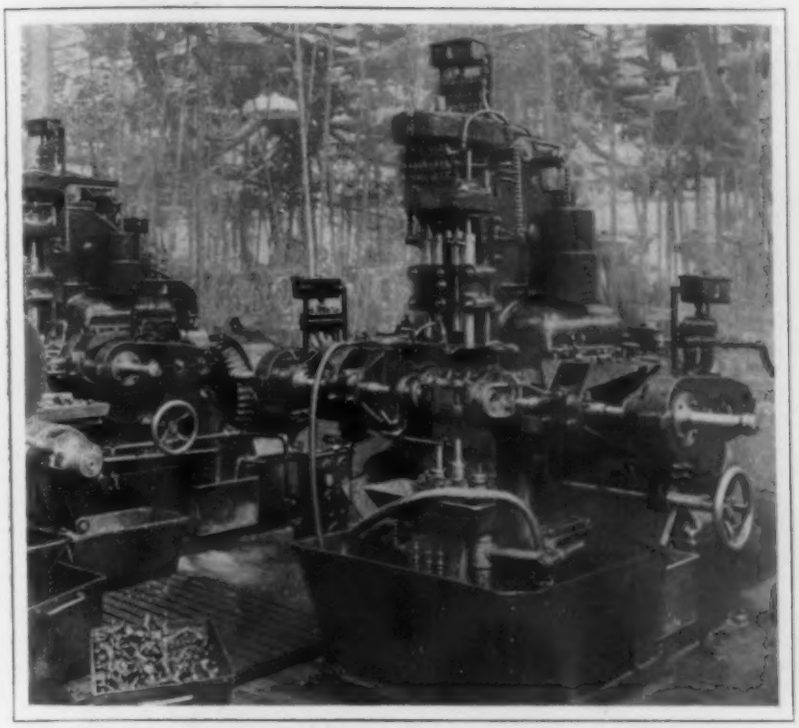
Today that man has his mother living with him in Detroit. He is getting $6 tucked away in his pay envelope every day; he is buying a home and his debts are paid.

"He is going to make a good citizen," said the chief.



Multi-tool Heavy Duty Automatic Reed L athes. Parts Moving Along the Carriers at the Back by Gravity Arrive Practically as Each Successive Operator Requires Them. There is Passing a Volume of Work Proportionate to the Production of the Entire Plant but the Only Evidences Are the Single Pieces Sliding Along at Regular Intervals from Tool to Tool

This is one kind of help that is being given. Poverty has been relieved and in its place comfortable homes established through the rehabilitation of the wage earner. Men with the blackest of previous records have been hired and are making good today in the Ford plant. The essential element under-



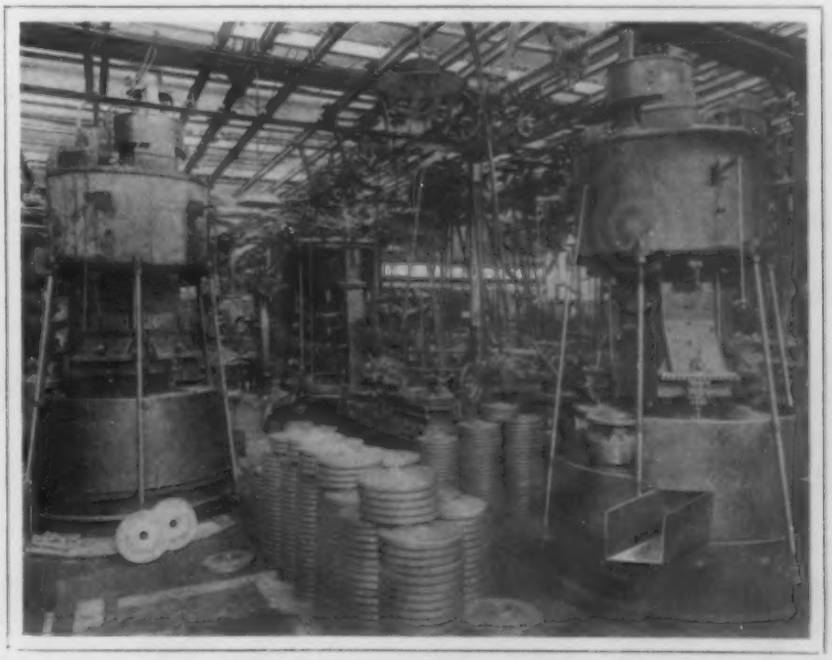
An Interesting Drill of New Design in Which the Steering Rod Yokes, Requiring the Drilling of 4 Holes, Each of Different Sizes and in Different Planes, Are Finished Two at a Time

lying this reformation is the fact that every employee starts with a new account and a clean page, for the company finds out all there is to know about him, and then they show him what they know. He probably lied about himself when he was hired. Many employees do; but the investigators finally land the facts. With nothing more to conceal and with the knowledge impressed upon him that here is the chance to wipe the slate clean, few men are able to resist the opportunity of decent, honest citizenship.

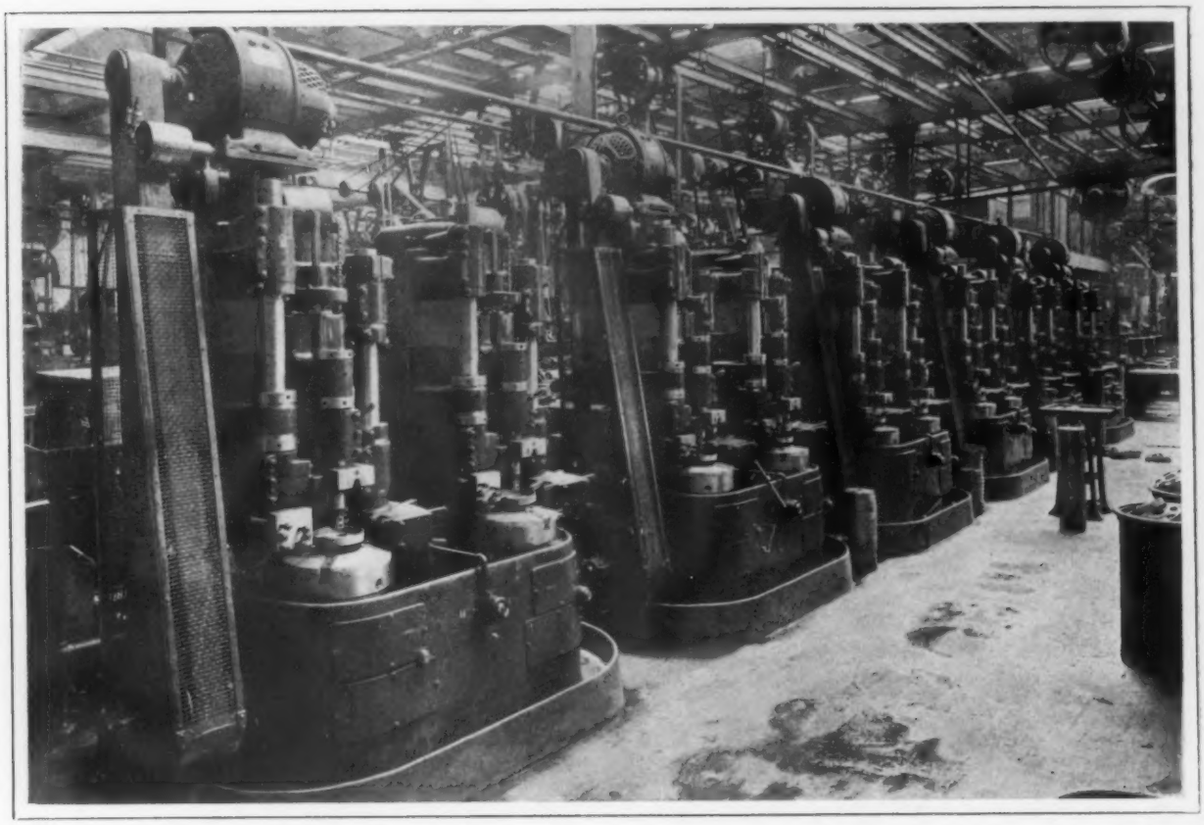
It is in this thoroughness with which the Ford method deals with the individual that its unique effectiveness lies. For the ignorant employee of foreign birth who can neither read nor write English daily classes are conducted. The men come of their own choice and the applicants are more than it has been possible to accommodate thus far. The classes are held at hours such that the men can come directly from the shop before going home. Classrooms have been fitted up in one of the factory buildings. A simple method of instruction is employed and the lessons concern, first, the daily routine through which the man goes, beginning with the rising in the morning, breakfast, going to work, returning home, going to bed. And the instructors are *the foremen from the shop who volunteer their services.* If there remain any doubting Thomases who question the real grip with which the Ford plan has taken hold of the Ford employees he may well spend an hour in these classrooms.

It is no longer possible rationally to discredit the disinterestedness of the effort with which this company has entered upon its programme of betterment. The entire organization is committed to it whole heartedly from the executive officers to the gang boss. It is no longer a theory or a post-prandial creed. It is an every-day working plan. The attitude of this company toward its employees reflects the spirit of a new conception in industry. The success which contents itself with the manufacture of a commercially profitable product is but partial success. The genius which directs the amassing of material wealth is but half served unless it also discharges its equal obligation to account for the welfare of the human agencies of industry which it controls. We cry "benevolent paternalism." There is need for paternalism. The greater must care for the less. We provide schools for the child. Instruction and discipline are compulsory, and it is well. But we forget that measured in the scale of knowledge and experience there are always children and grown-ups, pupils and teachers, and age is nothing. The Ford Motor Company is conducting a great school, a school in the art and science of living. The making of men is simply a department of the enterprise and as much a component part as the cost or accounting departments. There is no self-righteousness nor holier-than-thou sophistry. The work is accepted as an inherent responsibility and is discharged as such and it pays dividends.

And what has been the response of the employees as shown in their personal affairs and manner of living? The following comparison compiled from reports of investigators made at an interval of five months is a remarkable answer to



This View Illustrates in the Foreground Two of the Bullard Multi-Au-Matic 6 Spindle Machines on Which Flywheels Are Finished at the Rate of Nearly 300 Per Day of Eight Hours. In the Background is a Bausch Multiple Spindle Drill of Similar Design on Which the Flywheels Are Drilled and Tapped



Battery of Metal Turning Tools Fitted Up to Perform 9 Operations Simultaneously Upon the Reverse Gear Drum. They Represent the Marked Tendency Toward the Use of Vertical Rather Than Horizontal Spindle Tools. The Other Design Lends Itself to an Unusually Free Disposition of the Metal Turnings

the question. These gains have been made despite a decrease in number of employees.

What Changes Were Wrought in Five Months in the Personal Affairs of Employees, In Spite of a Decrease in Their Number

			Per Cent. Gain
Amount in banks.....	$996,418.00	$1,603,768.00	130.53
Amount in life insurance.	2,471,663.00	3,210,502.00	86.05
Value homes owned.....	468,230.00	613,220.00	87.60
Value lots owned.....	67,160.00	87,210.00	86.00
Value homes on contract.	3,282,331.00	4,480,503.00	95.53
Amount paid, homes on contract	1,111,258.00	1,693,937.00	135.90
Amount rent paid monthly	58,576.53	59,219.45	118.35
Amount rent paid weekly.	1,218.56	1,313.50	145.79
Amount board paid monthly	86,171.50	45,349.75	.....
Amount board paid weekly	12,906.82	9,195.20	.....

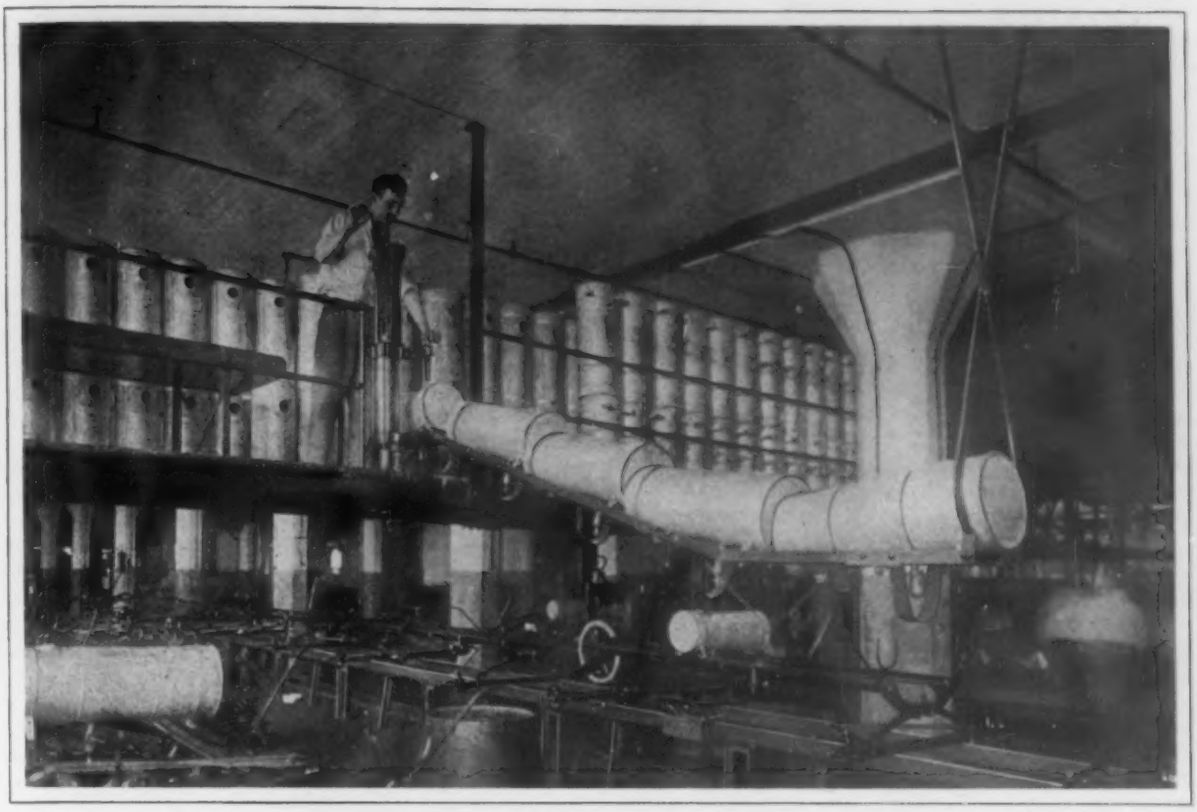
Average amount to savings account or home buying per man per month, $48.76.

Novel Design of Cincinnati Milling Machine Showing How the Cylinder Heads Are Chucked On a Rotating Fixture Four at a Time for the Milling of the End Flange

A map has been prepared dividing the city of Detroit into a number of residence districts of varying character—good, bad or medium—and the prevailing nationality of the residents in each. A tabulation has been made showing the number of Ford employees resident in each district at the inception of the plan and the number resident in each district after a five-months period under the plan. The migration from the poorer to the better neighborhoods and to new subdivisions where homes are being built as shown by the figures is most significant. The consumption of intoxicants has fallen off remarkably, while letters from police officials and the clergy state that the complexion of some of the communities where there are numbers of Ford employees has completely changed. In the shop the number of accidents has decreased beyond all expectation.

In this connection only one additional comment seems necessary and it is appropriate in the interest of fairness. The criticism has been made that there is a measure of coercion existent influencing employees to deposit their savings in the Highland Park State Bank, in which some of the Ford Motor Company officials are interested. It is true that where employees had no bank account at all this particular bank was frankly recommended with the statement that officials of the company were interested in it. It is equally true that employees already having accounts in other reliable banks were advised not to transfer them. The facts developed by investigation showed that prior to the inauguration of the profit-sharing plan 27.56 per cent. of all the employees' bank accounts were placed in the Highland Park State Bank. Five months later, during which period the total employees' bank accounts had increased by 130.53 per cent., the proportion placed in the above bank had increased to only 43.82 per cent. of the total.

But it is not to be thought that considerations



The Chasses of the Ford Car Proceeding Continuously in Process of Assembly. A Gallery Has Been Built Over These Tables on Which the Gasoline Tanks Are Stored. The Illustration Shows How the Tanks Are Filled and Slide Down at the Point Where the Chassis is Ready for the Assembly of the Tank

of commercial or mechanical importance have been submerged in a wave of idealistic altruism. Rather has the practical economic functioning of this organization been expanded beyond the limits of its specifically commercial operations to include a sociological work of foremost rank and lasting significance. To illustrate further the really exceptional initiative and sustained energy apparent in all phases of the Ford activities, a skeleton outline is also recorded here of some of the features of the mechanical progress attained during 1914. For in the shop ideas are being adopted continuously of as revolutionary character as the plan of profit sharing. The illustrations accompanying this article are in themselves striking evidence of some of the things that have been done.

The most important feature of general application in the machine shop has been the development of conveyors and carriers for the transfer of parts from one operation to the next in process of manufacture. So far as possible the piece is kept from touching the floor or from accumulating in receptacles during a series of consecutive operations in any department. This plan involved rearrangements of tools and the setting up of heating and annealing furnaces, enameling tanks and ovens in immediate juxtaposition. In general the axes of all horizontal tools are now in the direction in which the product is moving while most of the vertical tools are arranged in rows in the same direction. Most of the carriers are simplicity itself in design, as can be seen from the illustrations, and are as inexpensive as they are simple. They display no small ingenuity in their adaptation to the contour of the piece to be transferred and to the position in which the piece responds most easily to a gravity transfer. It would be difficult to estimate the extent to which the amount of stock in transit has been cut down through the elimination of the piles of partly finished material at each machine. The carrier delivers the piece to the machine operator within reach of his hand as he stands at his machine. He neither has to bend nor move in his tracks.

The furnace shown is typical of the way in which the hardening operation is made to work in consecutively with the machining operations without a carrying of the parts to some distant building and back again. These particular furnaces are located in the center of a group of gear hobbers. The furnace shown is one of new type with a preheating chamber above the cyanide pot. While one lot of gears is in the bath, the following lot is thus preheated without additional cost. The same idea

(*Continued on page 56*)

The Clothing of the Workmen Are Hung Under Canopies, Raised and Lowered as Indicated. A Man's Clothing is Protected and is Out of the Way

Leaves from the Diary of a Malleable Man

Observations on Many of the Practical and Metallurgical Problems Vital to Successful Operation of a Foundry

BY L. E. GILMORE*

Because of the necessity of keeping malleable iron within certain bounds and ratios of chemical composition, malleable founders should keep a close watch on all incoming pig iron by analyzing each shipment for silicon, manganese and sulphur. These three elements may have such wide variation in malleable Bessemer iron that an analysis is essential in each case. An occasional phosphorus suffices, as this element is almost invariably well within the malleable limit of 0.22 per cent., unless pig iron other than malleable Bessemer is purchased.

We were called to one malleable foundry in which air-furnace iron was coming out of the annealers with fracture showing steel-like crystalline rims of varying widths. Investigation proved that this trouble was caused by a low percentage of manganese due to the use in the mix of one brand of pig iron with less than 0.10 per cent. manganese. This was a case of lack of attention to the manganese in the pig iron when making mixtures. In another instance, trouble was encountered owing to excessively high sulphur in a pig iron. This was easily remedied by making mixtures so as to have the other elements in proportion to the higher sulphur percentages. In other cases, trouble has been averted by the checking of each shipment by analysis. In one particular case pig iron was received which analyzed about 1.00 per cent. silicon. This pig iron had been certified when purchased as 2.00 per cent. in silicon. In still other instances we found manganese above the maximum specified.

COST OF ANALYSES SAVED

The cost of analysis is saved many times over by the prevention of poor quality in castings, an item which cannot be estimated. Moreover, when the iron fails to correspond with the specifications, a direct and visible saving is often made in the form of rebates.

Some years ago charcoal pig iron was used exclusively in the manufacture of malleable iron, and it was with great caution that some malleable men undertook to use a little coke iron in their mixtures. In most sections of the country now coke pig iron has come to be used to the exclusion of charcoal, as it costs less. As many of the blast furnaces are substituting pig casting machinery in place of sand beds, a great deal of sandless pig is now on the market. We find foundrymen who seriously object to its use, as they say, "It works too high" in the air furnace. On the other hand, we have seen sand pig that worked fully as "high." However, the lack of sand may give rise to a slag somewhat deficient in the acid element, silicon dioxide, SiO_2, which might cause a more rapid oxidation of the silicon of the iron. Likewise, as there is necessarily much less free sand to be removed, the coating of slag on the surface of the iron would be thinner and therefore the iron of the bath would be heated through more quickly and be ready for tapping earlier.

In making a change of iron, the difference in characteristics of the older and newer brand must be taken into consideration. In one foundry in which a sandless pig iron had been customarily used in the cupolas, a change to a large amount of sand-covered iron was made. This immediately caused a slowing down of melting, as the coating of sand protected the sides of the pigs, the melting taking place from the ends only. While the pig iron required this additional time for melting, the coke was burning out as fast as formerly, so after a time the iron melted so low in the cupola that dull iron resulted. An increase in size of coke charges would have helped here, although the wiser course would have been to melt, as far as possible, only sandless pig in the cupola.

COAL OR COKE AS FUELS

In addition to the pig iron, another raw material of prime importance in a malleable iron foundry is fuel, usually coke or coal. In certain malleable cupolas coal is still used in some proportion, either in the bed or between charges, although coke is now generally recognized as the better fuel for a quick hot melt. The only advantage we have ever found in using coal in a cupola has been to quiet the fears of foremen or melters who, from long established precedent, believed that the use of coal was essential to hot melting. In one instance when such a partial use of coal was discontinued, the foreman reported that the use of all coke was causing an excessive amount of bad work through misruns. However, an investigation of the inspector's report revealed the fact that for the month following the elimination of coal in the cupola, the percentage of bad work was lower than during the month in which a mixed charge of coal and coke was used.

The most economical coke is the coke of best quality; ash 7 to 9 per cent. and sulphur under 0.85 per cent. is a good standard. For cupola use such a coke should have a physical structure not too easily crushed or broken, since fine coke is an abomination in a cupola. We have seen cheaper cokes used in which ash was greater than the standard. In such cases the larger amount of fuel required to melt the iron hot enough to run the thin sections found in malleable castings more than offsets the low first cost. As an instance of this, a certain by-product coke was tried and found wanting because of high ash. Another by-product brand, however, was used with great success, the coke being low in ash and sulphur. So the malleable founder does well to establish a standard quality for his coke. The same holds true in regard to the coal for his air furnaces and gas producers for gas engines and open-hearth furnaces. The best quality of gas coal, low in ash, not over 8 per cent.; sulphur under 0.85 per cent., and volatile combustible matter about 30 per cent., is a good standard for use in air and open-hearth furnaces.

In the same way, standards of quality established for all raw materials, such as sands, clays, oils, etc., are essential for smooth running of the foundry. The establishment of such standards might well be made a function of the laboratory.

PROBLEMS FOR THE LABORATORY

From day to day a great variety of analyses and data are required of the laboratory of a malleable plant. In one day we note a certain busy works

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laboratory called upon for help and information in addition to daily routine analyses of air furnaces, open-hearth and cupola heats. The purchasing agent wants to know whether a spelter with 0.06 per cent. iron at 20c. below the market price will be more economical to use than a spelter of iron content 0.03 per cent. iron. This involves figuring the amount of dross formed by the spelter and of calculating, at market quotations, the value of dross recovered, etc. The machine shop sends in a couple of samples of belt dressing and wants to know if rosin is present, as it has a deleterious effect on leather. The engineer has a sample of boiler compound to be looked into. The superintendent in a worried tone calls for a test on the accuracy of the annealing room pyrometers. Samples of steel taps, showing cracks in service, are brought in for chemical and microscopic investigation. The general manager has some malleable samples from a competitor that he wishes investigated and reported on. The cutting department reports some hard iron which must be traced back to faulty annealing or melting furnace operation, and inquires if reannealing will save this iron. Finally and lastly, the pattern shop wants to know why their aluminum is brittle.

When time and laboratory assistance permit, many profitable lines of investigation can be followed up, such as investigations by physical tests, chemical and microscopic analyses of malleable made under different conditions of mixture, furnace or annealing.

This Diary

is based on an extended practical experience in several large malleable foundries. In this interesting paper Mr. Gilmore tersely discusses the following points:

The cost of analyses of pig iron and raw materials is saved many times over by the prevention of poor quality.

The importance of the work of the laboratory and the possible investigations it can inaugurate.

A chemical and microscopical comparison of American and foreign malleable irons.

The annealing and heat-treatment should be regulated by reliable pyrometers.

Poor quality sometimes due to improper annealing and sometimes to faulty composition.

Inspection as a factor in reducing costs and preventing bad castings.

FOREIGN AND AMERICAN MALLEABLES COMPARED

Interesting samples of malleable made in foreign countries are now and again submitted to the laboratory for analysis and comparison with our American malleable. It has been our pleasure to examine many such comparisons, including samples of French, German, English and Japanese malleables. Most of the European or Réaumur malleables are of thin sections exclusively. Broken sections have a characteristic dove gray to crystalline fracture. In chemical analyses these irons differ from American black-heart air-furnace metal in their high sulphur and low phosphorus percentages.

Annealed samples of the Réaumur malleable, when polished and etched, by aid of the microscope reveal interesting structures. The extremely thin sections are composed largely of ferrite (pure iron) with but little temper carbon. All the iron carbide of the hard iron has been transformed into pure iron and free carbon. A good deal of the temper carbon so formed has been removed in the anneal by oxidizing gases. On the other hand, the thicker sections usually have a strongly marked pearlite structure. This is very characteristic of the Réaumur malleables. The pearlite shows that the decomposition of the iron carbides of the white iron has been incomplete. A certain percentage of the carbon is retained combined, causing the steel-like fracture. Investigations by Levy and Stead have shown that the retention of this combined carbon is due to some action of iron sulphide.

At one time we were interested in the making of a series of laboratory tests comparing five or six so-called mineral lard oils on the market. These oils were to be used in an emulsion with water in the thread-cutting department. Standard specifications had been drawn up and the price of the oil which most nearly corresponded with the standard was given, the cost of the others not being known until after the investigation was completed. It seemed quite significant, after submitting these oils to various laboratory tests and determining relative costs, that these prices corresponded almost to the cent with those charged by the makers with one exception. Later it developed that this last oil was of inferior quality, causing the low price. One sample of oil submitted was quickly rejected, in spite of evident good quality, because of high cost, together with the fact that it was a compound from which one oil separated out at low temperatures. Lewkowitch, in his masterly volumes on "Oils, Fats and Waxes," gives a pretty complete knowledge of their characteristics.

The malleable metallurgist finds iron made by the cupola process more difficult of control than that cast from the air furnace or open-hearth. One day the slag hole might be found "bunged up," due to lack of attention by the melter in charge. As a result of the large amount of slag formed and left inside, the cupola becomes "bunged." The blast pressure rises, and the air entering the cupola is localized and concentrated, causing the iron to melt dull and to become greatly oxidized. As a result, the percentages of silicon and manganese are reduced so greatly that the balance of the elements is destroyed and the annealing process is unable to dissociate the carbon from the iron and a brittle white iron comes from the anneal. This double dependence of the production of good malleable upon chemical composition and proper heat treatment, makes advisable the control of mixtures and annealing under the same authority.

CONTROL OF ANNEALING BY PYROMETERS

The annealing department is frequently a source of much worry to the malleable founder. In a foundry using no pyrometers, the control of temperature is dependent upon the judgment of the eye of the foreman or fireman. We have seen the annealing operation managed in this manner and on the whole producing good black-heart malleable, but in addition to the defect of guesswork temperature, this method of annealing was costly, as the length of time of firing was undoubtedly prolonged beyond the time necessary for completing the carbon transition.

In another foundry an intermittent type of pyrometer was used, the instrument being inserted in the annealer for a minute or so until it attained a maximum which was recorded. This type of instrument had to be cooled before a second use. So the temperatures of each oven in a large plant could be taken and recorded only every two or three hours. These instruments required frequent com-

parison with a standard pyrometer, as after a time they were liable to give incorrect readings. Moreover, we note instances in which the firemen's knowledge of the possible inaccuracy of the instruments, together with the judgment of the eye, has caused them to set down observations other than those actually recorded by the pyrometer.

A third system of temperature observation noted in successful operation is a continuous recording type of pyrometer. By such an installation a permanent record was made of the temperature fluctuations of each annealer at intervals of a few minutes. The recording instruments were kept in a locked room to which only those authorized had access. For the firemen's benefit, an instrument was placed in the annealing room where the temperature could be observed by switching with a turn of the hand to any annealer desired. Such a system does away with guesswork as to temperatures attained in specific locations and also eliminates human fallibility in recording observed temperatures. A permanent record of this kind would have shown when the excessive temperatures were attained, instead of being forced to wait, as was the case in a certain instance, until the annealer was opened and dumped. This unusual temperature was clearly shown by the extraordinary caking of the packing and the sagging of the stacks. Extreme fineness is often observed as a contributing cause to fusion of packing. We have cases on record of castings accidentally exposed to the direct action of the gases in the annealers by loss of packing through cracks. Castings so exposed have been so badly oxidized as to become much thinner in section and entirely decarbonized. Again, lack of care in packing castings costs heavily in the straightening required.

ASSIGNING CAUSES FOR DEFECTIVE IRON

Defects in quality of iron may sometimes be traced to the annealing department and at other times to faulty chemical composition of the white iron. A certain executive, obsessed with the desire to save fuel and reduce costs of operation, gradually cut down the time of firing ovens and the maximum temperatures to be attained, until some parts of the annealers failed to reach necessary temperatures and hard, under-annealed iron resulted. Chemical analyses showed no reasons why these castings should not have annealed under proper conditions, this fact being further demonstrated by a second treatment. On the other hand, certain iron, found hard after annealing, revealed under microscopic analysis a structure in which a portion of the carbon is retained as iron carbide after annealing, and chemical analysis reveals the cause of this in the proportions of the elements, silicon, manganese, and sulphur.

In one foundry, we find the method of annealing is to continue firing until a temperature of about 980 deg. C. is reached, when the firing is stopped and the ovens allowed to cool. This high temperature has the disadvantage of causing short life for the pots, an excessive fusion of the packing, and an undue amount of straightening of castings.

Such high temperatures serve no useful purpose. W. H. Hatfield, in one of his valuable researches on annealing malleable iron, makes these deductions, which furnish us with a rational guide for annealing temperatures: "1. That the free carbide was broken up into free carbon and iron between the temperatures of 800 and 900 deg. C. 2. That the carbide resulting from the resolution of the hardenite decomposed between 650 and 750 deg. C. i.e., immediately after or during the hardenite-pearlite change."

Expressed in less technical language, we might say that between the temperatures of 800 and 900 deg. C., about 0.8 to 0.9 per cent. of the carbon is retained in the combined condition, the remainder of the carbides being broken up into free carbon and iron. No further free carbon is precipitated at any temperature much above 750 deg. C. As the iron cools slowly between the temperatures 750 and 650 deg. C., the 0.8 per cent. combined carbon is precipitated in the form of temper carbon. Oliver W. Storey, in his more recent researches, places the latter temperatures at 775 to 700 deg. C. We have examined a number of samples of malleable in which the last change referred to above did not take place even when the iron was slowly cooled through those ranges of temperature. In such cases, the trouble is due to the composition of the hard iron.

FACTORS IN LOWERING COSTS

A careful study and standardization of the annealing operation in conjunction with a standardization of mixtures and furnace operation is a means of great cost saving to the malleable founder.

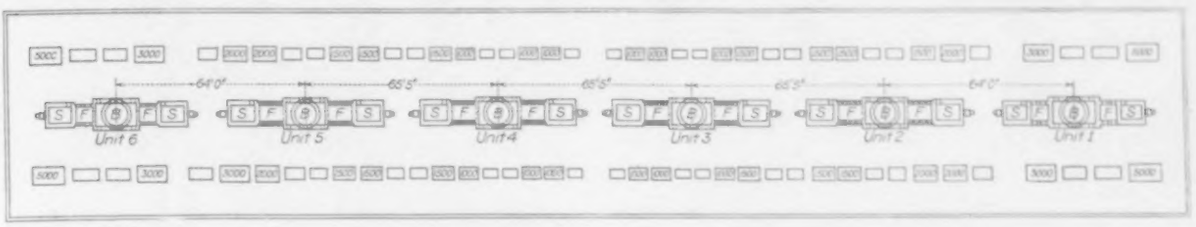
Another means of cost saving is a skillful handling of the hard iron inspection department. Such a great variety of castings is handled, that causes for rejection vary widely in different cases. One customer orders work that is to be nickel plated, requiring a surface without a blemish. Another writes that strength and ductility of metal are essential and surface is of minor consideration. The inspection room, therefore, needs to know exactly what is to be avoided in each case and the requirements of each customer. A sample casting makes a good standard for comparison. One customer returns castings because a small lug is missing. Another rejects work because solid iron is found where a hole was desired. With a sample for a guide, such defects would easily be caught in the foundry or inspection room. Even from very simple patterns molds are sometimes made with spaces for metal where there should have been cores. One foundry produced a number of barrels of plugs with a square raised nut from a customer's pattern. In this case the square nut was intended to be a core, as the casting was a plug with a square, sunk in a socket.

IMPORTANCE OF EFFICIENT INSPECTION

The inspection room should be one of the greatest aids in reducing bad work. A careful and accurate classification of defects greatly assists here. A report of such and such a percentage of bad work is a little help, but the real aid is a strict analysis of the causes of the percentage of bad work. The assigning of the wrong cause is worse than useless. In a certain foundry a great hue and cry was raised of "high" iron that was supposed to be the cause of pin holes. Careful investigation revealed the fact that on days when the iron was nearly gray, that is, "low," there were just as many pin holes as on other days, and also that the pin holes were found only in a certain class of castings with a smooth, flat surface some 6 in. in diameter.

A reiteration of unsupported suppositions is footless, but a careful analysis of causes of defects, which gets right down to fundamentals and the truth, is always helpful. In one foundry which is noted for the fine finish of its molding and in which the percentage of bad work had been averaging not over 15 per cent., a reduction of 50 per cent. in this percentage was accomplished by having a man of intelligence and tact follow the defects back to their sources and co-operate with the foundry foremen in remedying the conditions responsible for these defects.

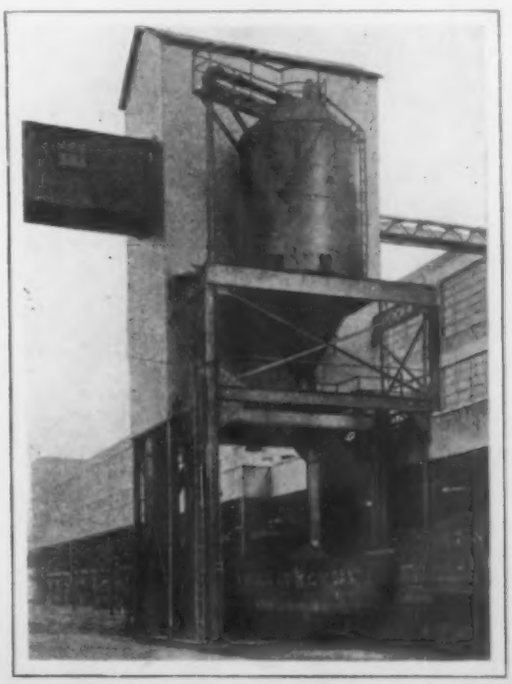
In this diagram-plan of the forge shop, S stands for the coal combustion furnace; F, for the heating furnace; B, for the waste-heat boiler. The two rows of rectangles represent hammers and trimming presses, those without numbers being the presses. The numbers give the capacity of the hammers in pounds



Utilizing Waste Heat in a Drop Forge Shop

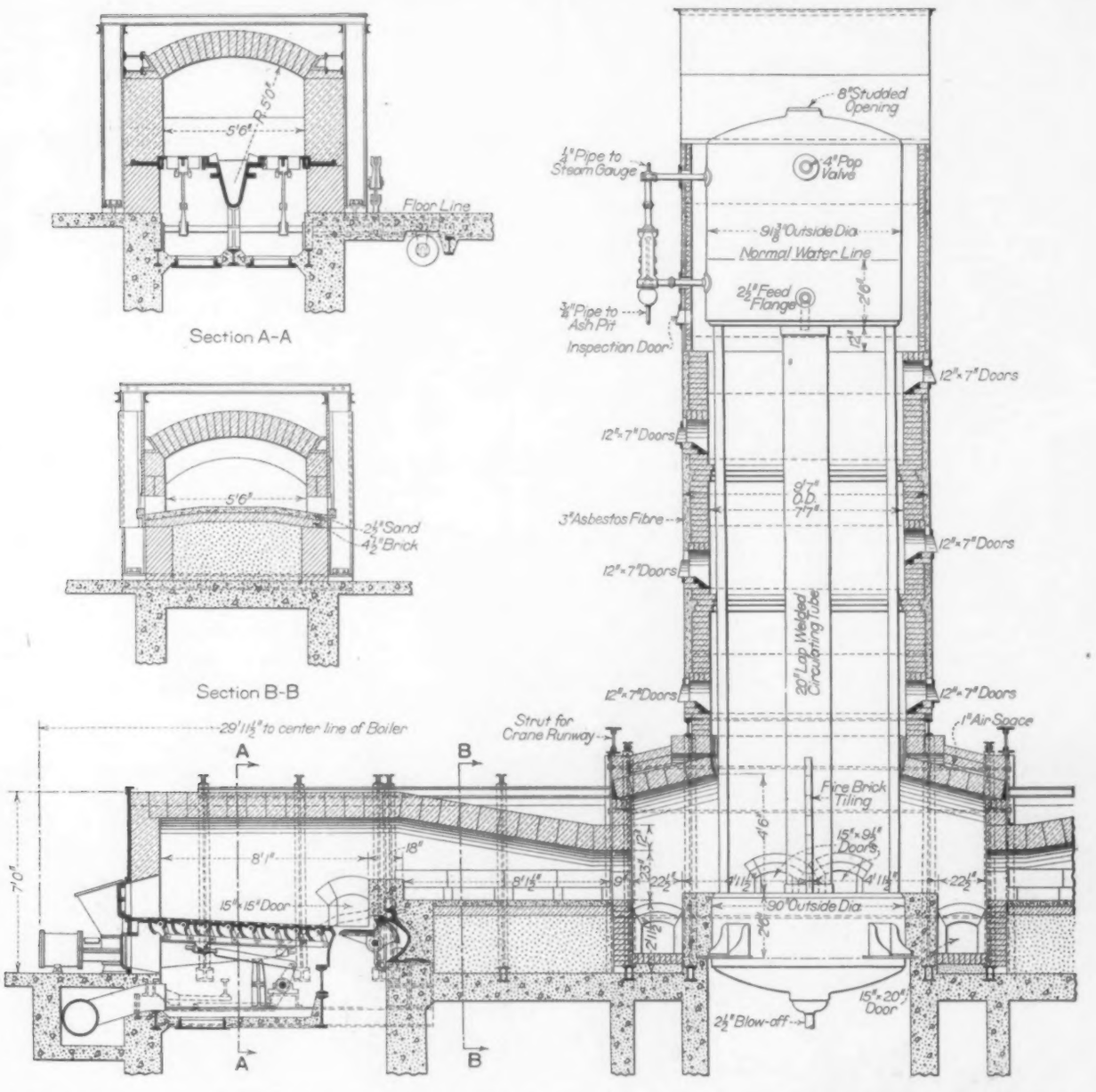
Hot Gases from Furnaces Used to Generate Steam in Dodge Brothers' Plant—Interesting Coal Conveying and Ash Handling Equipment

An interesting installation designed to utilize the waste heat from the heating furnaces in their forge shop for generating steam in boilers, this steam being used for operating the hammers and presses, has recently been made in the automobile plant of Dodge Brothers, Detroit, Mich. The hot gases pass from stoker-equipped coal combustion chambers to the furnaces for heating the metal for forging, and the heat that is left passes on to the boilers where it is absorbed for steam production. Two stokers and two furnaces are connected to each boiler and form a composite heat utilizing unit. The complete installation will consist of six such units, or six boilers with twelve furnaces and stokers. Two of the units were installed several months ago, and while data are not yet available showing the saving in fuel cost by the installation, results have been sufficiently satisfactory to warrant the installation of the remaining four units, which are now being erected. When these are in operation all the oil burning furnaces in the forge shop will have been replaced.



The installation necessitated the re-arrangement of the forge shop. Formerly the oil heating furnaces lay

In the Lower Left May Be Seen the Vertical Boiler with the Combustion Furnace at the Left and the Heating Furnace Between the Two. The Picture at the Right, Also Taken During Construction, Shows One of the Coal Bunkers and the Tubes of a Boiler Beyond. The Tower Houses the Coal Crushing and Elevating Apparatus, and Alongside Is the Tank to Which Ashes Are Sucked by Air



Each Waste Heat Unit Is Symmetrical About the Center Line Through the Boiler. The Small Cuts Are Sections of the Stoker Chamber and the Forgings Heating Chamber

along the side walls, as described in these columns January 2, 1913, and between these were two rows of hammers and presses, leaving a wide center longitudinal aisle in the building. The shop incidentally was equipped with a crane having a runway the width of the building, which is 400 ft. long and 70 ft. wide. The new boilers and furnaces are being installed through the center of the shop and to provide sufficient space, it was necessary to move the hammers and presses back near the side walls, room being afforded for this change in location by the removal of the old heating furnaces. The changes also necessitated the substitution of a crane on each side of the forge shop in place of the former crane that spanned the building.

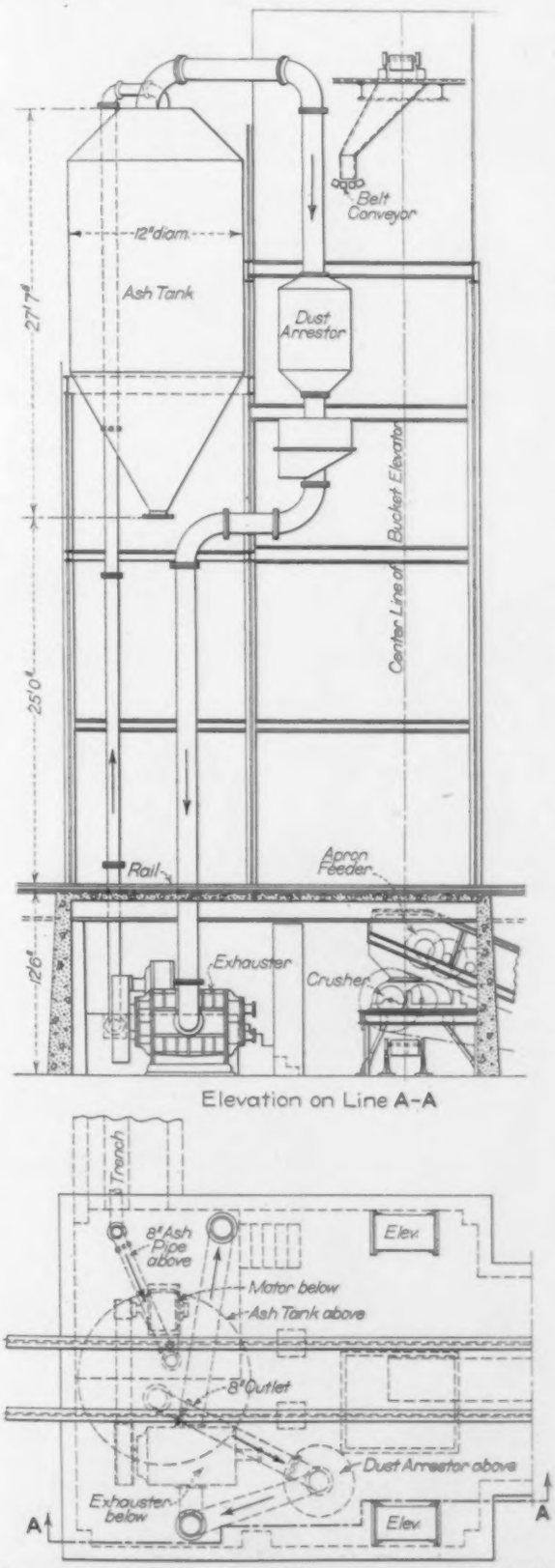
The complete installation includes a mechanical coal handling plant and a pneumatic ash handling plant, practically eliminating all hand labor in the handling of fuel and ashes.

The waste-heat boiler is of a special vertical water-tube type of 333 hp. rating, arranged for double end operation, the waste heat coming from two furnaces, one on each side. The boiler consists of an upper or steam drum and a lower or mud drum joined together by straight tubes. It has 136 4-in. tubes 22 ft. long, and in addition in the center a 20-in. re-circulating tube. The water heating surface is 3307 sq. ft. and the super-heating surface 88 sq. ft. The boiler setting is steel jacketed. Water passes up the small tubes and down the re-circulating tube. The gases from the furnaces pass between the tubes and around the steam drum to the stack, there being but one pass for both furnaces. The boilers were furnished by the Wickes Boiler Company, Saginaw, Mich.

The under-feed mechanical stokers are of the self-cleaning type with steam operated rams and clinker breakers and motor driven draft fans. Each unit of two furnaces is guaranteed to heat 2400 steel billets per hours to temperature suitable for drop forge work, in addition to making the surplus heat available for steam production in the waste heat boiler. The stokers are the Jones, made by the Underfeed Stoker Company of America. There are two openings on each side of the furnaces so that each row of hammers is served with metal with equal convenience. Each boiler furnishes a steam supply for four 5000-lb. hammers or for more hammers of smaller capacity. The hammers are also connected with an auxiliary steam line from the main power plant so that additional steam can be used for their operation if the supply from the

waste-heat boilers is insufficient. An exhaust steam line carries the exhaust steam from the boilers to a 750-kw. Allis-Chalmers low-pressure turbo generator which generates electricity for the operation of motors. Other exhaust lines are connected with the same generating unit. Provisions have been made for the installation of a second low-pressure turbo generator for the utilization of exhaust steam.

The coal handling plant is located a short distance from one end of the forge shop. Run-of-mine coal is brought to the plant in bottom dump cars from which it falls into a track hopper. From the hopper it passes upon a steel apron feeder which delivers it to a two-roll crusher. The handling and crushing equipment is located in the basement under the coal tower and ash tank, shown in one of the illustrations. The apron feeder is 30 in. wide, 23 ft. long between centers and has a 22 deg. incline. It is operated at a speed of 6 ft. per min. The fuel passes from the crusher to a bucket elevator with 18-ft. horizontal centers and 60-ft. vertical centers and buckets 18 x 24 in. This bucket elevator is operated at a speed of 40 ft. per min. and raises the coal to the top of the tower to a belt conveyer. The belt conveyer runs the length of the forge shop, housed above the roof. A section of the housing is shown joining the tower. This conveyer distributes the crushed coal to the steel bunkers above the stokers from which it is spouted into the stoker magazines, one bunker supplying two adjoining stokers. The belt conveyer is 433 ft. between centers. The belt is four-ply rubber, 20 in. wide and is operated at a speed of 300 ft. per min. As a part of the conveyer equipment is a self-propelled traveling tripper by means of which fuel can be dumped into any bunker desired.



Plan and Elevation of the Coal Tower Showing How Coal Is Received from a Track Hopper and Showing Also the Pneumatic Ash Handling Equipment

The coal handling plant is entirely electrically operated. The apron conveyer and the pivoted bucket elevator are each driven by a 5 hp. motor running at 1130 r.p.m., the belt conveyer by a 10-hp. motor running at 860 r.p.m., and the coal crusher by a 15-hp. motor. The motors are all General Electric 440-volt three-phase, 60-cycle alternating-current machines. The coal handling equipment was furnished by the Link-Belt Company.

A pneumatic system is used for the removal of ashes. The self-cleaning stokers drop the ashes into a pit underneath the forge shop floor. Alongside these pits and running the length of the shop under the floor and extending to the basement under the coal tower and ash tank is a tunnel in which is located an 8-in. steel pipe with intakes for each ash pit. This pipe runs to the top of the ash tank above a railroad switch track and at one side of the coal tower as shown. The ash tank is steel, cylindrical in form with a cone top and bottom, 12 ft. in diameter and 14 ft. high, having a capacity of 40 tons. Ashes are drawn through the conveyer pipes by a vacuum on the ash tank. For maintaining this vacuum a No. 7A Wilbraham-Green exhauster is used, power being supplied by a 75-hp. Allis-Chalmers 3-phase, 60-cycle, 440-volt motor. The exhauster is located in the basement under the ash tower. Gases drawn from the tank are passed through a dust collector of the wet type before entering the exhauster. Ashes are quenched before entering the tank by a water spray located in the pipe near the tank. Special fittings at all turns in the ash pipe are provided with removable backs. Ashes from the tank are spouted into the railroad cars. The ash handling equipment was installed by the Green Engineering Company, Chicago.

No efficiency tests have yet been made, but the builders have guaranteed an efficiency of 50 per cent. for the boilers when operated at rated capacity. The complete waste heat plant, including the coal and ash handling system, was installed under the direction of Smith, Hinchman & Grylls, engineers and architects, Detroit.

A committee to investigate the relative merits of turbo-blowers and the reciprocating engine for blast furnace blowing may be appointed by the board of directors of the American Institute of Mining Engineers. A separate committee is now at work looking into the desirability of appointing the committee.

Better Living Conditions for Coke Workers

Some Account of the Improved Relations between the H. C. Frick Coke Company and Its Employees Due to Welfare Measures

(With Supplement)

By a fateful coincidence this issue of *The Iron Age* contains an account of the welfare features of the H. C. Frick Coke Company's work and on another page the obituary of Thomas Lynch, the president of that company, who was in a large degree responsible for the introduction of these fine innovations in the relations of employer and employee in the Connellsville coke region. There is no doubt that Mr. Lynch's personality, thrown into the scale along with all the betterment measures carried out by his company, accounts largely for the good feeling that has existed between the Steel Corporation and the workers at its Connellsville mines and coke ovens.

In the early days of his connection with the coke industry as superintendent of a single mine and the ovens it supplied, Mr. Lynch saw that the living conditions of the workers had much to do with the failure of the latter to meet the expectations of their employers in respect to output and quality of products. The class of labor employed in the coke regions is probably harder to handle and to get best results from than any other labor in the great industrial fields. A rough estimate of the nationalities of the men employed by the Frick Coke Company shows that about only 20 per cent. are Americans. The main body is made up chiefly of Slavs, Hungarians, Poles and Italians, and no less than 20 different nationalities are represented in the Connellsville and other coke-producing fields. These men, when they come to this country, are ignorant of the English language, and most of them know nothing about the laws of health.

A GREAT CHANGE IN LIVING CONDITIONS

Mr. Lynch fully believed that under proper working conditions in the coal mines and at the ovens, together with the introduction of modern conveniences and betterments in their home surroundings, these men would become more efficient employees and more desirable citizens. That his faith was not misplaced, conditions as they now exist among the miners and coke workers of the Frick Coke Company amply prove. Instead of living in tumble-down shacks, devoid of comfort, without sanitary conveniences of any kind, and in some cases hardly fit to house animals, the men now have comfortable houses. Sanitary conditions are good; gardens and lawns are among their possessions, and they have access without charge to swimming pools, shower baths and entertainments of various kinds, while salaried teachers instruct their children in housekeeping, cooking, sewing and other domestic pursuits. Several of the illustrations accompanying this article give a clear idea of what is being done for the children of employees in these directions. Others show typical streets in different coke towns, which take their names from coke plants. It will be noticed that all streets are well graded, being raised in the center to afford drainage. Most of them have concrete curbing, with good walks, and there are also concrete drains for taking care of water. The streets and alleys on which company houses are located are kept scrupulously clean, and garbage and other refuse is removed regularly. No rubbish is allowed to accumulate, all being removed by the company without charge to its tenants.

The houses shown in the illustrations are typical in appearance and design of nearly 8000 houses owned by the Frick company. There are from four to five rooms in the cheaper houses, and up to eight and 10 rooms in the better class. The houses are built in blocks of two, each capable of housing two families. Most of them contain five rooms—kitchen, dining-room, parlor and two bedrooms. Such a house rents for $6 to $8 per month, the rent charged representing actual cost of construction and maintenance, including interest, insurance and other fixed charges. While getting rent at cost the employees enjoy many privileges and conveniences for which the ordinary tenant is charged.

PRIZE LAWNS AND GARDENS

Striking features in connection with the houses of which views are given are the well-kept front and side lawns and the vegetable gardens. Such lawns and gardens are a possibility for all Frick Coke Company tenants. Most of the latter raise all the vegetables they use in the summer and also those they store for winter use. This year 98 per cent. of all the vegetable gardens connected with the nearly 8000 houses owned by the Frick company were actively cultivated. The gardens enable the employees to keep down the cost of living and in addition the work is regarded as recreation. Each yard is surrounded by a wooden paling fence, which is whitewashed once or twice a year, the lime and brushes being furnished by the company. Every year prizes are offered for the best kept lawns and vegetable gardens and interest in these contests is very keen. They have been going on since 1909, and have been so successful that they will doubtless be continued for many years to come. To each coke plant having 300 or more ovens, there is a first prize of $10 in gold, a second prize of $5 and a third of $3 for the best kept lawns and flower beds, and similar prizes for the best kept and most prolific vegetable gardens. At coke works having less than 300 ovens, the first prize for the best kept lawns and flower beds is $6, the second prize is $3 and the third prize is $1. For the best kept vegetable garden there are two prizes, the first being $4 and the second $2. Judges on lawns and flower beds are usually women, while those for best kept vegetable gardens are selected from members of civic societies and sometimes are farmers living near the coke towns. In 1913 the Frick Coke Company paid out $489 for first prizes for vegetable gardens, $252 for second prizes and $115 for third prizes. It also paid out last year $276 in first prizes for best kept lawns and flower beds, $157 in second prizes and $43 in third prizes. The contests are decided and the prizes awarded when the lawns, flower beds and gardens are at their best, this being usually from July 15 to

Welfare Provisions for Coke Workers

The playground at the upper left shows also the town of Marguerite, noteworthy for its well kept streets, and the playground at the right is at the Phillips works of the H. C. Frick Coke Company.

Of the second pair of pictures, the one at the left gives a view of the swimming pool at the Redstone mine and the other the pool and, in the background, the amusement hall at Leisenring No. 1 plant. The small frame houses are dressing rooms, one for each sex. The walks and walls of the pools are of smooth concrete.

The lower left picture shows the shower baths, swimming pool and porcelain wash stands for employees at the Standard works. The lower right view illustrates the popularity among the employees of a pool near one of the large coal mines.

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The well kept lawns, the concrete curbing and the concrete walls supporting the front yards along the public road at the Standard works are shown in the upper left view. The recreation park for children and adults near a shaft at the Leisenring No. 2 works is shown at the upper right.

The left middle picture gives an idea of the typical double frame house occupied by miners and coke workers. The company owns about 4000 blocks of these and each house rents for $6 to $8 per month. At the right is a photograph of a sewing class in the visiting nurses' instruction and training class headquarters at the Lambert mine.

At the bottom are two prize winning lawns and flower gardens, one at the Leith mine and the other at the Standard works.

August 1. When it is considered that these contests are held each year in nearly 70 mining towns and that careful records of the results are kept by the company, some idea can be formed of the amount of work they involve. However, their value to the men and to the company has been fully proved.

Another important work the Frick company is doing for its employees is the establishment of welfare houses in charge of competent women as instructors. So far two of these have been provided, but others will likely be started in the near future. One is located in the town of Lambert and is in charge of Mrs. Emma Nickum, a graduate nurse of the Episcopal Hospital in Philadelphia, and the other is at the Calumet works, in charge of Miss Marcie L. Decker, a graduate nurse from the Moses Taylor Hospital at Scranton, Pa. In these houses the children are taught sewing, baking and cooking—in fact, given a full course in domestic science, and every expense for materials and instruction is borne by the company. Miss Decker has at present seven classes and about 25 girls in each class. The girls take keen interest in their work, and already have made garments for their own wear. In the summer the boys work in the gardens and do other work around these welfare houses. Mrs. Nickum and Miss Decker are also self-constituted boards of health, and make regular visits to all the homes in their districts where sickness is reported and see that proper medical attention is given. Each is provided with a horse and buggy for making these visits.

RECREATION AND ATHLETIC GROUNDS

There are also playgrounds for the children in all the mining towns of the company for the use of the boys and girls and these are equipped with swings, large sand boxes for the children to play in and other accessories.

Athletics also form an important part of the welfare work and the Frick Baseball League containing 30 clubs was organized a few years ago, each team playing a regular series of games with the others. The expenses of these teams, which are composed entirely of employees, are borne by the company, these including uniforms and equipment, and also traveling expenses. For some years Mr. Lynch donated a handsome silver cup to the victorious team. No charge is made for admission to the games. Last year the company spent about $15,000 in maintaining and equipping the teams of the Frick League. There are also basketball teams whose contests are held in the amusement halls of the larger works.

RAISING STANDARDS OF LIVING

The Frick company is constantly endeavoring to raise the standard of living conditions among its employees in every way, realizing that in a few years the boys and girls will be men and women on whom will largely depend the perpetuation of the present teachings. For the men in its employ it seeks to provide all conveniences. As a rule coal miners and coke workers are of a roving disposition and are constantly shifting from place to place. To overcome this, the Frick company decided to give the men conveniences that would appeal to them in their work in the mines and at coke ovens and also better houses in which to live. The result is that the men are loyal to the company, as a rule continuing in its employ as long as they remain in the coke regions.

A recent innovation was the establishment of two large bath houses, one at the Standard works, its largest coke plant, and the other at the Collier works. The bath house at the Standard works is a brick building 30 x 55 ft. with steel supports and slate roof. The floor is of concrete; there are windows on all sides and four ventilators. The building is steam-heated, a line running from the boiler house just adjacent. The bathing facilities consist of a concrete plunge bath 6 ft. wide by 15 ft. long, also 16 shower baths on each side of the building, the shower rooms being 3 ft. x 3 ft., and there are dressing rooms 3 ft. x 3½ ft. The men go to the bath house in the morning, putting on their working clothes there, and after coming out of the mines in the evening they take shower baths and put on their street clothes in which to go home. Two porcelain washstands, one in each end of the building, have six lavatories each, all fitted with nickel trimmings. There are also two toilets. At present 85 men are using this bath house. The one at the Collier works is similarly equipped and is also used by a large number of miners.

One way in which the Frick company employees cut down their living expenses is in getting coal at its cost to the company. What are known as house coal bins are provided at nearly all the shafts, and the miners can make a further saving by wheeling the coal from these bins to their houses. All the Frick mining towns now have pressure water and the company is putting water in the houses as fast as it can. At present a hydrant located between two blocks of houses furnishes water for four families, but there is more or less trouble from freezing in the winter, and eventually all houses will be equipped with running water.

NO RENT CHARGED IN SHUTDOWNS

The Frick company does not charge rent to employees of a mine or coke oven plant that may be temporarily shut down. The company not only believes firmly in the good results of welfare work, but also in paying the highest wage that business conditions warrant. In the past seven years it has made three voluntary advances in wages, and for several years has been paying the high rate of $2 a day for common labor. It has not had a labor trouble at any of its coal mines or coke plants for about 20 years. Its employees have come to feel that it has their best interests at heart, and that they will be accorded fair treatment, not only as to wages, but in all other respects. The officers of the company have plans in mind that will contribute still further to the advantages of its workmen. The employees participate in the Carnegie Steel and United States Steel Corporation pension fund, and 390 are now receiving pensions under this system.

The H. C. Frick Coke Company owns and operates 70 different coke plants with an aggregate of about 22,000 coke ovens. Most of these plants are in what is known as the old Connellsville region, of which Connellsville and Greensburg, Pa., are important centers, but some are in the adjoining Klondike field. The history of the company goes back to about 1872 when H. C. Frick and several associates organized the firm known as Frick & Co., which latter became H. C. Frick & Co. From having only a few hundred beehive ovens the firm grew, steadily acquiring additional coal properties and ovens. Eventually it was incorporated as the H. C. Frick Coke Company and in turn absorbed the McClure Coke Company, the Connellsville Coke & Iron Company and the J. M. Schoonmaker Coke Company. When the H. C. Frick Coke Company was taken over by the United States Steel Corporation in 1901, its operations were extended to include practically all the coke properties of the other interests merged in the corporation.

Constitution of the Iron-Carbon Alloys

A Chemical Theory to Explain the Different Properties by the Existence of Ferrated Carbides

BY GEORGE AUCHY*

To the industrial chemist—the connecting link between science and manufacture—the solution, phase, or allotropic theory of his revered guides and mentors, the scientists, has points that cannot readily be assimilated. Although his respect for their wonderful work as a whole is hearty and profound, he is all the more impelled to levity and irreverence in regard to certain points.

CONFLICTING THEORIES OF THE SCIENTISTS

It is not plain to him how the solidification curves of steel prove solid solutions. Again, the conception that an 0.90 per cent. carbon steel exists only in two conditions—austenitic and pearlitic—both soft, fills his soul with gloom and despair. And this is not materially lightened by the scientists' own repudiation of this revelation of their diagram, and their forcible substitution of an equally untenable theory, that, for an instant of time, martensite flashes up and disappears, and that although austenite may be trapped by quenching in high hypereutectoid steels, where it exists through a high and narrow range of temperature only, it cannot be so trapped here in eutectoid steels where it exists through the entire range of temperature from solidification down to pearlite.

Again, cementite is at one time a soft, dark etching constitutent (to the chemists the idea of the metallographist that pearlite-cementite etches white seems manifestly wrong); at another time an intensely hard white etching one. The industrialist is at perfect liberty to take his choice or to distinguish between them as he sees fit, provided always he adheres resolutely and unflinchingly to Fe_3C as the composition of both. Austenite is anything he likes, provided he exercises self-control enough to refrain from imputing to it more than 2 per cent. carbon in solid solution, and it also is sometimes white and sometimes dark etching, sometimes hard and sometimes soft.

Martensite, which is hard and dark etching, is merely a form of austenite (although this latter is soft and white etching, if not invariably so according to the scientists), and therefore it has long since been ignominiously "fired" from the equilibrium diagram. And the incongruity of the fact that the soft form of austenite may contain 2 per cent. of carbon with the fact that the hard form contains only 0.89 per cent. of it is met by the assumption that it is not really the martensite that is hard, but the ferrite that has separated.

Here the industrialist must balk and must train with the small but irrepressible Sheffield group of dissenting scientists. For the fact that quenched beta iron when pure is not hard is to him an impressive one, while the carbon brake theory on the other hand seems to him like the old and well-known green cheese theory for the constitution of the moon, exceedingly hard to refute, but at the same time far from satisfying.

But the scientists freely and frankly concede the unsatisfactory and unfinished state of their theory, and at no time have they made any display of dogmatism or claim of finality. Far from it! And it would be an exceedingly small and gratuitous performance to deal smartly with their few and inevitably temporary and evolutionary discrepancies and differences of opinion without at the same time paying grateful and admiring tribute to the tremendous value of their work and their own interpretation of it, in general.

SIMILAR THEORIES PREVIOUSLY SUGGESTED

But, before suggesting a chemical theory—one that explains different properties by different carbides—the writer need hardly premise that this idea is not his own, but comes from certain of the scientists'—Professor Arnold, lately Upton, and twenty-two years ago, Prof. E. D. Campbell, who put forth the extremely plausible theory that there are very many such carbides and that they are derivatives of the well-known series of hydro-carbon compounds, but not as yet specifying or particularizing, as far as the writer is aware. Also in Russia Vittorf deals with the carbides Fe_3C, FeC_2, and FeC; but just how, the abstractors apparently have not taken the time to find out, or if they themselves understand what their author is trying to get at, probably none of their readers do.

So, if the writer in this present scheme works over anything of Vittorf's without acknowledgment he does it unwittingly. Nor does he seek to apply Professor Campbell's "ferro-carbon" theory, but he does make use of Upton's Fe_2C (a compound) previously isolated by Campbell and Kennedy) although in an entirely different way from that of Upton himself. Arnold's hard $Fe_{24}C$ he would characterize as an anomaly, and would stoutly maintain that a highly attenuated sub-carbide cannot be hard. To be hard, it must be a per-carbide.

THE SUGGESTED FERRATED CARBIDES

The writer's suggested carbides are, besides cementite, the following: the austenites, ferrated Fe_2C compounds; the martensites, ferrated Fe_2C compounds, and hardite, as the writer will term it, a ferrated FeC compound.

The austenites are the primary constituents, those existing in the molten metal. They are ferrated like metallic oxides are hydrated—that is, they are definite chemical compounds. Solid, they are soft and white-etching, but growing harder with lessening ferration. In detail, they are 0.22 per cent. carbon austenite, $Fe_3C \cdot 93Fe$; 0.44 carbon austenite, $Fe_3C \cdot 45Fe$; 0.89 carbon austenite, $Fe_3C \cdot 21Fe$; 1.76 carbon austenite, $Fe_3C \cdot 9\,Fe$; 3.45 carbon austenite, $Fe_3C \cdot 3Fe$; 6.67 carbon austenite-cementite Fe_3C. The last one not ferrated, not white-etching, and, therefore, not a true austenite, but included here because a primary constituent, and the base of the austenites.

Molten steels of exactly 0.22, 0.44, 0.89 or 1.76 per cent. carbon are made up entirely of a single carbide, the corresponding austenite. Between any two of these carbon limits are solutions of the two corresponding austenites in proper proportion. These austenites all transform into the corresponding martensites—hard and dark etching—upon solidifi-

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cation of the steel, except the 1.76 carbon austenite, $Fe_3C \cdot 9Fe$, which does not so transform at once, but gradually, and with a separation of very hard Fe_3C when the arcm line is reached, leaving the eutectoid martensite. But the Fe_3C combines again at Ar_1 and at once changes to the original 1.76 carbon austenite, and this at 615 deg. to the corresponding pearlite, a mechanical mixture.

SOLUTION OF MARTENSITES WITH EACH OTHER

With the eutectoid and the hypo-martensites the writer intrepidly follows the scientists in defying the diagram and considers these martensites as forming solid solutions with each other, with iron, Fe, separating from the hypo-martensites at the Ar_1 point—perhaps induced thereto by the expansion of the gamma to beta change—and converting them into the eutectoid or 0.89 carbon martensite, but the Fe recombining again at Ar_1 and the martensites then changing back to the original austenites, as do the two higher martensites, 0.89 carbon martensite and 1.76 carbon martensite, also at this point. That the Ar_1 point is a referration, followed by a change back to the austenites, and not a change to pearlite, is indicated by the micro-structures, homogeneous above Ar_2, again homogeneous in the Ar_1 range. That the change is clear back to the austenites and not to the martensites—that is, that it is a change to a different carbide and not merely a referration—is indicated by the magnitude of the arrest. Then at 615 deg. C comes the change from the austenites to the corresponding pearlites, which change is a simple deferration, although if soaking be indulged in here, the martensites form.

But this deferration is not a sure and easy process, but a difficult and uncertain one. Quick cooling from Ar_1 to 615 deg. seems to be necessary for the complete change. If the cooling be slow, the austenites become fixed and persist; that is, the deferration at 615 deg. C is not accomplished, and the completely cooled steel is, therefore, a mixture of austenite and pearlite instead of being—in steels above 0.22 per cent. carbon—all pearlite. In other words, it is abnormal, and in steels above 0.22 per cent. carbon, the white-etching constituent is a "metastable phase" in solutionist parlance, although differing from the cast iron metastable phase in being the result of slow cooling instead of quick cooling. Annealing, therefore, favors the abnormal structure, and to normalize, although not with certainty, we must reheat and air cool, or as this probably gives some martensite, we must harden and draw.

Similarly in heating up, the cementite, Fe_3C, becomes ferrated or transformed into the austenites around 615 deg. C, but for a complete conversion, both of this freshly formed austenite and of the abnormal austenite already in the steel from the preceding cooling, into martensite at Ac_1, heating up must be slow, we can imagine, and if this critical-range-austenite theory be true, it will sometimes happen that high carbon steels, although ferrite-skinless, will not harden or will not properly harden. As a matter of fact, this does sometime happen to the great mystification of the tool-maker.

So according to the chemical theory, the white-etching constituent of hyper-eutectoid steels is never hard cementite, Fe_3C—that theory denies both the existence of free cementite here, and its hardness where it does exist—but always soft austenite, and the white-etching constituent of hypo-steels above 0.22 per cent. carbon never ferrite but austenite, and so far from austenite being hard to get as is commonly supposed, it is on the contrary hard to avoid and is seldom absent from any steel.

THE THEORY APPLIED TO CAST IRON

In cast iron, hardite is an intensely hard, unstable white-etching ferrated per-carbide, $FeC \cdot 5Fe$, containing 3.45 per cent. carbon. Formed, if the cooling be quick, at about 1200 deg. C by the reaction of 1.76 carbon austenite upon 6.67 carbon austenite-cementite, $Fe_3C \cdot 9Fe + 2Fe_3C = 3FeC \cdot 5Fe$ solidifying at 1130 deg. C, and then gradually transforming, although only in part and not completely, into 3.45 carbon martensite $Fe_3C \cdot 4Fe$, this portion then turning into 3.45 carbon austenite at Ar_1 and deferrating into 3.45 carbon pearlite at 615 deg. C. That is, a 3.45 per cent. carbon white iron is made up of intensely hard white-etching hardite $FeC \cdot 5Fe$ partly decomposed into soft dark-etching 3.45 carbon pearlite. Under 3.45 per cent. carbon, we have in addition the pearlite from the 1.76 carbon austenite which is the first constituent to solidity if the carbon be under 3.45 per cent. But the hard unstable per-carbide $FeC \cdot 5Fe$ dissociates completely into Fe and C if the cooling be slow, in which case it is formed at 1300 deg. instead of 1200 deg. C, and the dissociation occurs before solidification.

CONCLUSIONS

In conclusion, the writer wishes to acknowledge the amazing effrontery of his critical range austenite conception, and to admit that he does not see how the scientists can be wrong in their interpretation of the white constituents of pearlitic steels, yet at the same time cannot see how he himself can be wrong either—in hyper-steels at any rate. For with him a pin point plows through the alleged "intensely hard—harder than martensite" white network of an annealed 1.35 carbon file steel as through cheese.

Also the writer wishes to state that he does not insist on his theory that the austenites and martensites and "hardite" are definitely ferrated chemical compounds, and would be almost as well satisfied to consider them, as he at first did, as solid solutions in indefinite proportions of Fe_3C, Fe_2C and FeC, respectively, in Fe.

The former theory is the more attractive one because there seem to be definite breaks in properties be regretfully abandoned in favor of the indefinite at 3.45 per cent., 1.76 per cent., 0.89 per cent., etc., of carbon. But this theory, of course, involves the assumption of segregation in eutectoid and other single austenite steels (with regard to carbon, not with regard to impurities) occurring either only after the deferration, 615 deg. C, or else not at all. And if this assumption is a too violent one, the definitely ferrated chemical compounds idea must be regretfully abandoned in favor of the indefinite solid solutions of Fe_3C, Fe_2C and FeC in Fe idea. Or best of all, the difficulty may be met by assuming definite ferration at solidification.

Annual Meeting of Metal Trades Association

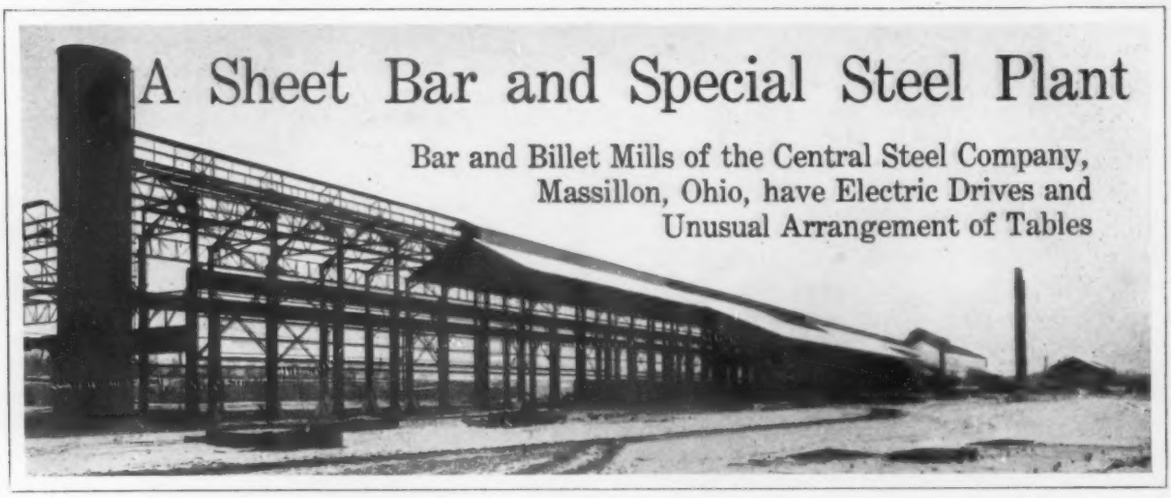
The National Metal Trades Association will hold its annual meeting at the Hotel Astor, New York City, April 13 and 14.

Not a single passenger of the 188,411,876 carried in 1914 on all of the 26,198 miles of track of the entire Pennsylvania Railroad system was killed in a train accident. The various roads are the lines east and west of Pittsburgh, Long Island; Cumberland Valley, Baltimore, Chesapeake & Atlantic; Maryland, Delaware & Virginia, Vandalia and Grand Rapids & Indiana.

The Commonwealth Adding Machine Company, Muskegon, Mich., has leased the plant in that city formerly occupied by the United States Gas Machine Company. It has taken an option to purchase the plant.

A Sheet Bar and Special Steel Plant

Bar and Billet Mills of the Central Steel Company, Massillon, Ohio, have Electric Drives and Unusual Arrangement of Tables



EARLY in 1914 plans were started at Massillon, Ohio, by officers of the Massillon Rolling Mill Company and others for the building of an open-hearth steel plant primarily to supply sheet bars for this company, which has always bought steel in the market. The result was the formation of the Central Steel Company, with a capital of $5,000,000, half common and half preferred, and about half of each kind of stock has been issued. In April the Central Steel Company set to work to build a modern open-hearth steel plant at Massillon, and it is now nearing completion. The first foundations of the mills were placed on July 8, 1914. The open-hearth furnaces, of which there are three at present, four soaking pits and all the steel buildings will be completed in the present month. Much of the mill machinery is on the ground, and the plant is expected to be ready to make steel about April 1, 1915.

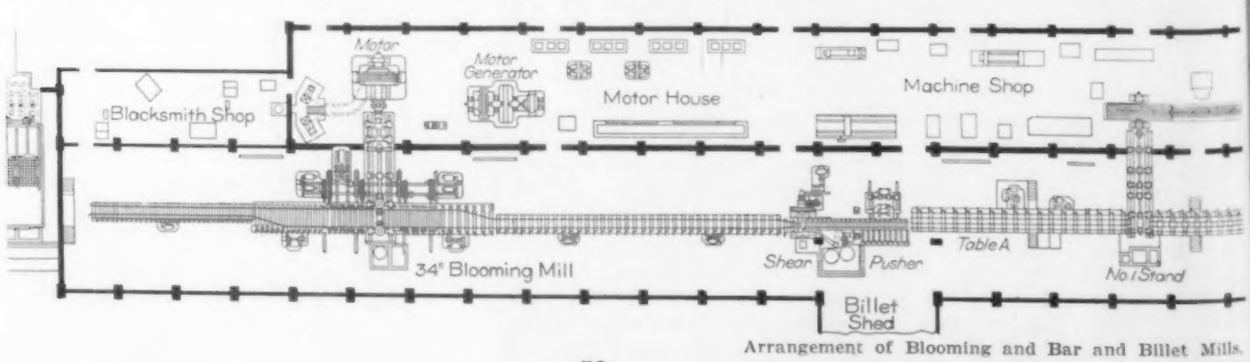
The striking feature of this plant is that it will be driven throughout by electricity, no steam or hydraulic power being included. The power will be furnished partly by the Massillon Rolling Mill Company, produced by a Westinghouse low-pressure turbo-generator set. The turbine being run by exhaust steam from the sheet mill engines gives power at a very low cost. The remainder of the power will be furnished by the Massillon Electric & Gas Company.

The site of the new steel works is directly south of the sheet mills of the Massillon Rolling Mill Company, being located between the tracks of the Baltimore & Ohio, Wheeling & Lake Erie and the Pennsylvania Lines West, and contains about 100 acres. Each of the above railroads will have switches directly into the yards. At the extreme southern end of the property are the track scales, yard master's office and the track system for making up trains for the different departments. All cars for the Central Steel Company, Massillon Rolling Mill Company and the American Stamping & Enameling Company will be handled in this main yard. Conveniently near is the stock yard building for the open-hearth plant. It is 500 by 90 ft., out of which three switching tracks lead up an incline to the open-hearth floor. The track system for the open-hearth and stock yard is laid out in such a way that it is completely independent of any other tracks, and so can be used for open-hearth purposes only. This avoids interference of any other switching necessary to serve the other part of the plant.

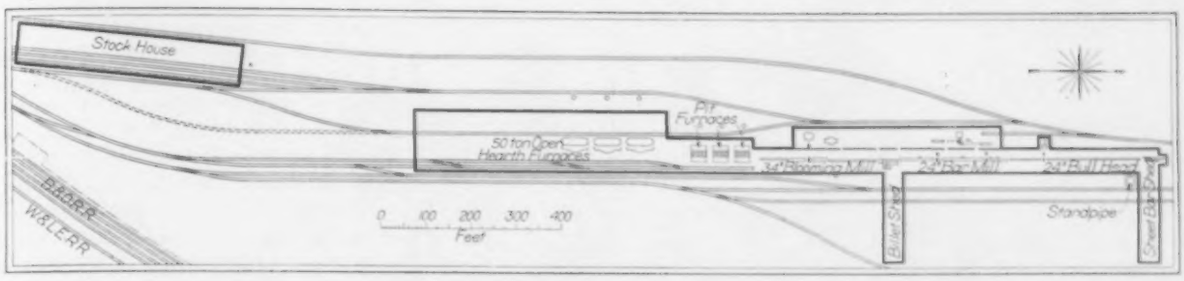
THE OPEN-HEARTH BUILDING

is 563 ft. 6 in. long, located north of the stock yards, and room has been provided to lengthen this building to take in 12 open-hearth furnaces. The present building is large enough for seven furnaces of 50 to 60 tons capacity each and foundations have been put in all, but only three are being erected complete. The furnace building proper is 60 ft. wide, with a 20-ft. leanto on the west side and on the east side a pit building 55 ft. wide, making the total width 135 ft. The charging floor is 6 ft. above the mill floor and yard level. This was done to give proper ventilation to the valves and chambers underneath. A short trestle with slight grade at either end permits of handling buggies both ways.

The three open-hearth furnaces are being built by the S. R. Smythe Company, Pittsburgh. They are stayed by structural steel struts riveted at their base to the sub-structure of the furnace and held by heavy rods at the top. The hearth proper is built into a very heavy riveted steel plate pan, which in turn is carried on beams resting on brick piers alongside of the slag chambers. The clear opening on the center of the hearth is 16 ft. The over-all dimensions are 59 ft. by 16 ft. 3 in., and the inside measurement of the hearth proper, 32 ft. by 14 ft. The slag chambers are 4 ft. wide for air chambers



Arrangement of Blooming and Bar and Billet Mills.



Gereral Plan of the Plant

and 3 ft. 9 in. for the gas. The checker work is located to the rear underneath the charging floor. The gas chambers are 23 ft. long, 6 ft. 10½ in. wide and 17 ft. 6 in. deep, and the air chambers 23 ft. long, 9 ft. 10½ in. wide and 17 ft. 6 in. deep. The checker work is of special design, the checkers proper ocupying a space of 1898 cu. ft. in the gas chambers and 2725 cu. ft. in the air chambers. Stacks are 5 ft. 9 in. in diameter inside, and 160 ft. high. The furnaces have water cooled ports designed by the builder. Each has three Knox water-cooled doors 3 ft. 6 in. x 2 ft. 9 in. The doors are operated by motor through a worm gear device of the Youngstown Engineering Company.

Natural gas will be used in the open-hearth furnaces, but space is provided for gas producers.

On the charging floor is an Alliance Machine Company high type charger of 7½ tons capacity. On the pouring side are a 100-ton, four-girder Alliance Machine Company ladle crane and a 15-ton general service crane. There are three platforms each 122 ft. 6 in. long on the east side of the pit, and a double track runs the full length, connected by several crossovers for ingot car and slag car service. The ladles, furnished by the Riter-Conley Mfg. Company, are of 90 tons capacity. Special slag pots to be used for drying ladles are designed by the Central Steel Company.

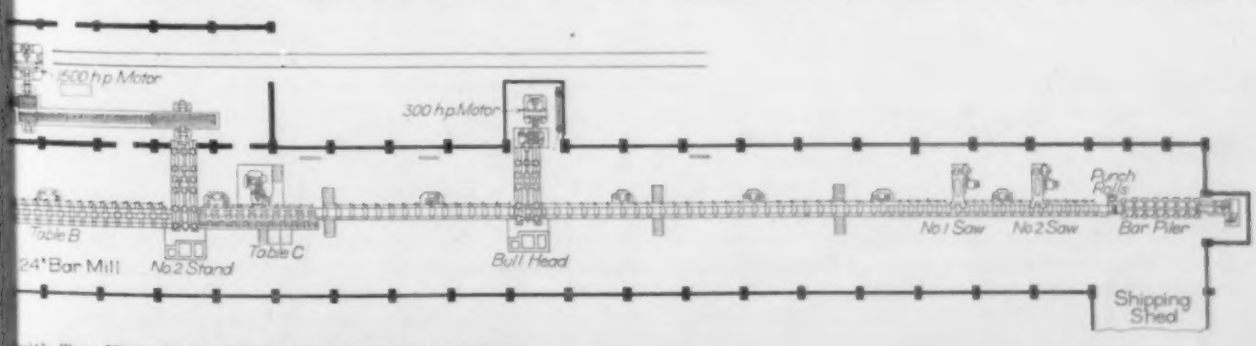
At the north end of the building is a bay of 24 ft. 6 in. for stripping ingots, equipped with a Morgan Engineering Company 100-ton electric screw stripper. North of the stripper bay are the soaking pits in a building 196 by 55 ft., with a leanto the full length, 20 ft. wide. The soaking pit furnaces, of which three are built at present, are in the main building. All operating mechanism is in the leanto, which prevents injury by cranes and avoids danger to the workmen. Each soaking pit has four holes 8 ft. by 6 ft.

THE BLOOMING MILL

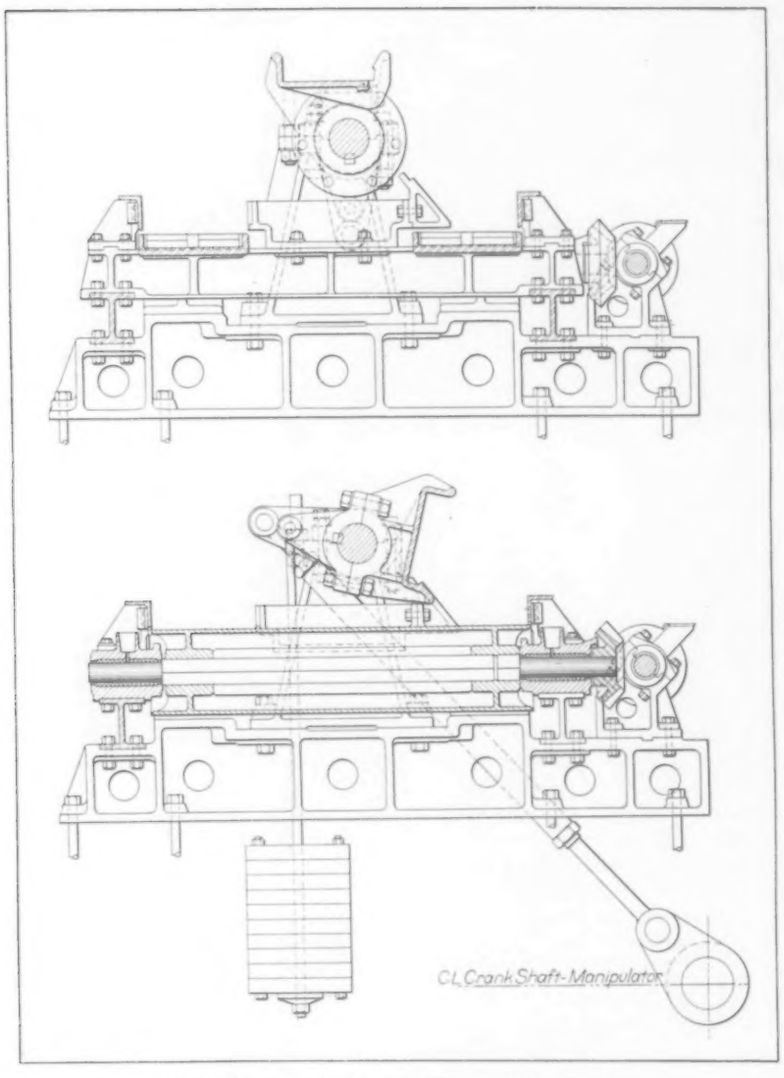
Adjoining the soaking pit building to the north is the blooming mill building, 330 by 55 ft. The ingots will be placed by the soaking pit crane directly on the approach tables of the blooming mill and no ingot cars or chairs are necessary. The blooming mill is a two-high 34-in. reversing mill made very heavy on account of the special steel which will be made in the open-hearth plant. The housings are link shaped. The screw down is driven by two 80-hp. motors, and the rolls are balanced by an invididual accumulator. The lower and vibrating spindles are connected to the rolls and pinions by Mesta universal couplings, eliminating lost motion and giving very small friction losses. The roll housings and pinion housings are steel castings. The latter are fully inclosed and splash oil lubrication will be used. The pinions are 34 in. in diameter and 48 in. face, 20-deg. involute helical cut teeth. The motor connections are universal couplings of Mesta design. The main mill motor, furnished by the Westinghouse Electric & Mfg. Company, will develop 640,000 ft. lb., and will run from 50 to 75 r.p.m. normal speed. It is driven by direct current of about 600 volts generated in a flywheel motor-generator set.

The blooming mill approach tables are 62 ft. 4 in. long; the front mill table is 46 ft., the rear mill table 42 ft., and the mill run-out and shear approach table, 108 ft. long. The mill tables are of heavy steel castings and the rollers are 14 in. in diameter. One front and one rear manipulator of the Wellman-Kennedy type are electrically driven, and arranged in such way that they may be connected up or run separately. Manipulator fingers are provided on the front side only, and are mechanically connected to one side guard, so that they will always be in the right position to tilt the piece. The electric control of the blooming mill has been worked out to a high degree of efficiency, and this feature merits treatment in a separate article.

At the end of the shear delivery table is an 800-ton electrically driven shear, capable of cutting a 12 x 12-in. bloom, or a 36-in. x 6-in. slab. The gag of this shear is operated by hydraulic power furnished by the blooming mill accumulator, hydraulic power being used on account of the difficult design necessary for this operation. The clutch of the shear is operated by an electric motor by means of a cam. The gauge connected to this shear will measure billets from 6 in. to 12 ft. long. It is made extremely heavy to avoid any bending. A motor is provided to set the gauge and also to lift the stock, so that billets may be run out on the push-off tables. The front rollers of the rear shear table may be dropped to allow crop ends and crosscut billets (the latter being cut the cross way of a slab) to drop to a chute underneath the rear table, which guides



with Two-High Tables Which Make Rolling Continuous



Cross-Section of Table A Showing Tilting Trough

these pieces into buckets located in the pit on one side of the tables. An automatic push-off places the long billets not used in the sheet bar mill in a cradle located at one side of the push-off table.

Adjoining the main mill building opposite the shear tables and crop chute is located at right angles a billet storage house, 200 by 44 ft. A 10-ton crane located in these buildings can run, on account of the girders of the billet shed being extended in the main building, over the push-off table and crop chutes and pick up billets and crop ends placed therein and carry them into the billet shed or load them into cars located on tracks in the billet shed. This eliminates all conveyors.

THE BAR AND BILLET MILL BUILDING

adjoins the blooming mill building and is 572 ft. long and 55 ft. from center to center of columns. There are two three-high 34-in. mills and one two-high 24-in. bullhead. These mills are arranged in tandem, as will be noted from the ground plan. The two three-high stands are served by two-high tables to eliminate lifting and tilting tables and also to make the process of rolling practically continuous. The operation of the bar and billet mill is as follows:

The bloom is delivered on table A from the blooming mill shear, and enters a flat pass in No. 1 stand. After edging on the intermediate table B, it enters the edging pass of No. 2 mill, after which it is delivered on table C, and here a manipulator lifts the billet to table rollers on top of the main table driven by friction of the lower roller. The top rollers running the opposite direction from the lower rollers deliver the piece to the top flat pass of No. 2 mill; then running over the top rollers of table B to the top pass in No. 1 mill, it is delivered into a tilting trough on top of table A. This trough turns the piece 180 deg. and deposits it on the main rollers of table A, thereby reversing the direction of the piece, and delivering it into the lower flat pass of No. 1 mill, then over table B into the lower flat pass of No. 2 mill, which delivers the piece over table C to the bullhead table. After passing through the bullheads and over the bullhead delivery tables, the piece is run in front of the saws, where it is cut into proper lengths and is then deposited by means of a pinch roller into a bar piler. These tables and arrangement of mills were designed and patented by W. T. Martersteck, mechanical engineer at Youngstown, Ohio, and are being built by the William Tod Company, Youngstown.

The two three-high stands are driven by a 1500-hp. a.c. Westinghouse motor, by means of a rope drive furnished by the Mesta Machine Company, Pittsburgh. The bullheads are driven by a geared 350-hp. Westinghouse motor. The gears of the bullhead motor are helical and fully inclosed so as to be dust proof and splash oiling may be used. All pinion housings on these mills are inclosed and have pinions with teeth cut involute.

THE SHEET BAR SHED

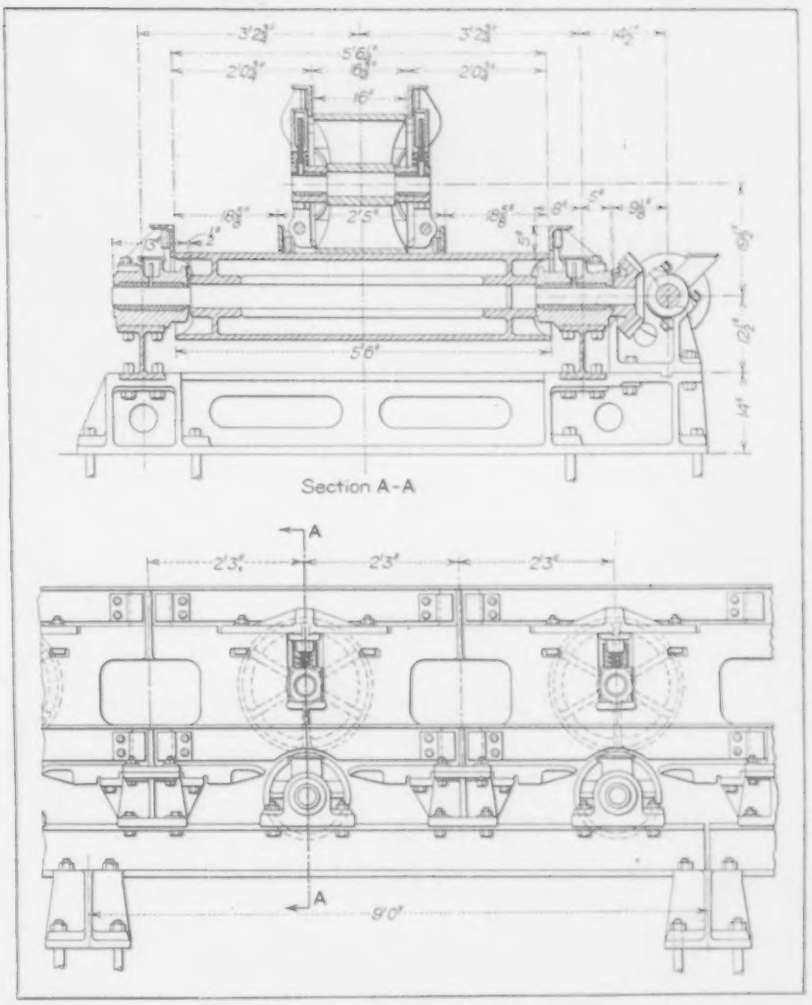
At right angles to the main building and at the end is the sheet bar shed, which is 200 ft. long. Its 10-ton crane runs overhead of the bar piler and is thus able to pick the bars out of this machine and deposit them in the sheet bar shed or on cars placed on tracks therein. At the end of the sheet bar shed is a shear table, which will deliver the sheet bars to a shear located in the main hot mill building of the Massillon Rolling Mill Company.

Adjoining the main building to the west in the form of a leanto is the motor house and machine shop building, 462 ft. long and 45 ft. wide. This is inclosed on the mill side by a 7-ft. concrete wall and Fenestra sash 12 ft. high, while the rest of the partitions are self-centering plaster, with cement mortar 2½ in. thick. The gable end and the west walls are inclosed with a 4-ft. concrete wall and Fenestra sash 26 ft. high. This building contains the large blooming mill motor and pinion housings, also the flywheel motor-generator set, two 500-kw. rotary converters, transformers, main switchboard and other auxiliary electrical apparatus. In it are also the machine shop, the 1500-hp. motor and the rope drive for the 24-in. mill.

From the above description and the accompanying plan it will be noted that the main building and crane runway are practically one unit, including the open-hearth pit, soaking pit, blooming mill and sheet bar mills. The entire process of making sheet bars from the charging of the pig iron and other ma-

terials into the open hearths is continuous, and there is no rehandling at any stage of manufacture. All cranes in the main building, on account of the above arrangement, can be used in any of the departments, which is a decided advantage. All precautions have been taken and necessary equipment installed to provide safety as far as possible for the employees.

All structural work was fabricated and erected by the Fort Pitt Bridge Works, Pittsburgh. The 700-ton shear was built by the Mesta Machine Company, Pittsburgh. The windows throughout are Fenestra steel sash furnished and glazed with ⅛-in. factory ribbed glass by the E. F. Hauserman Company, Cleveland. The blooming mill, blooming mill shear and rope drive were furnished by the Mesta Machine Company, Pittsburgh; the sheet bar mill trains, bullhead train, all bullhead tables, saws, saw tables, bar piler and the sheet bar shear with its tables, by the National Roll & Foundry Company of Avonmore, Pa.; the nine cranes, apart from the ingot stripper, by the Alliance Machine Company. W. T. Martersteck, mechanical engineer of Youngstown, Ohio, had charge of all foundation work, track work, the erection of the mill machinery and electrical equipment.



Cross-Section and Elevation of Table B

In addition to sheet bars, half or more of which will be used in the sheet mills of the Massillon Rolling Mill Company, the plant will make chrome-vanadium, chrome-nickel and other alloy steel billets which will be shipped to another plant and worked up into various forms. The present capacity is about 9000 tons of steel per month, but the finishing mills and equipment are sufficient to take care of the output of twelve 50 to 60-ton open-hearth furnaces. The surplus of sheet bars will be sold in the Canton, Ohio, and other nearby districts where sheets are largely made.

The officers of the Central Steel Company are John C. Neale, president and general manager; R. E. Bebb, first vice-president; Frederick J. Griffiths, second vice-president and general superintendent, and Charles E. Stuart, secretary and treasurer.

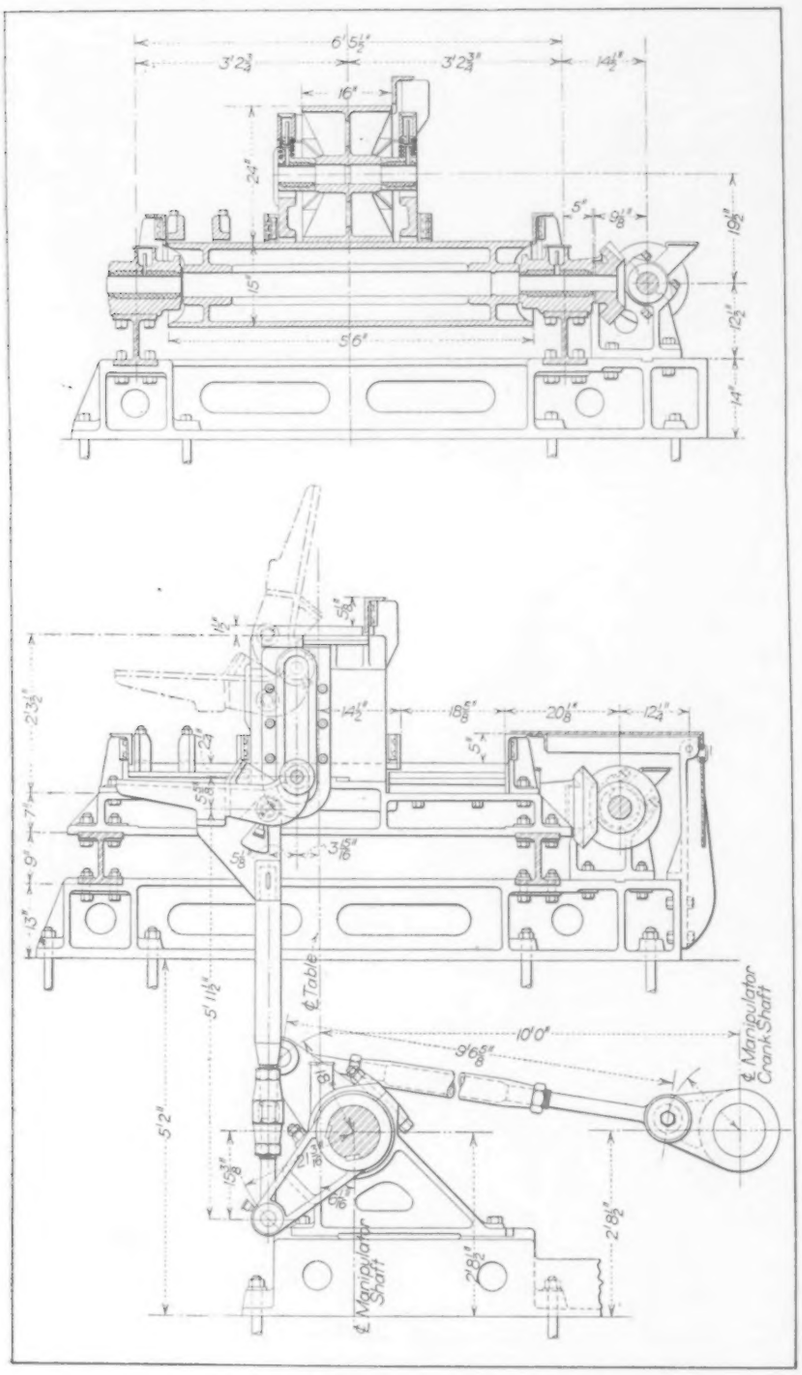
New Dodge Products Sales Plan

For the purpose of securing better efficiency and better service to the manufacturing interests at large, the Dodge Sales & Engineering Company, Mishawaka, Ind., has been incorporated to distribute the products of the Dodge Mfg. Company in the United States and abroad, together with engineering connected with sales. This new company takes over the present sales and engineering departments of the Dodge Mfg. Company, warehouses, and branch sales and engineering stations at Chicago, Minneapolis, St. Louis, Atlanta, Cincinnati, Pittsburgh, Philadelphia, Boston, New York, Dallas and Indianapolis. The Link-Belt & Dodge Products Company will handle all sales and engineering from Seattle and Portland, Ore. Under this arrangement the Dodge Mfg. Company expects to devote its entire time and energy to the manufacture of power transmission machinery and appliances, elevating and conveying equipment, water softeners, etc., and to the design and production of other lines kindred thereto.

Duncan J. Campbell, for many years general sales manager of the old company, goes to the new corporation as vice-president and general manager, taking with him the general sales department at Mishawaka and the entire branch house organization. For the present, at least, there will be no changes. C. R. Trowbridge, who has been associated with Mr. Campbell for a number of years, continues in charge of advertising and sales promotion, with offices in the Mishawaka Trust Building, Mishawaka, Ind. While there has been some talk of moving the general offices to Chicago, for the present at least they will remain at Mishawaka, which has been the home of the Dodge Mfg. Company for 31 years.

The Link-Belt & Dodge Products Company was incorporated in October under the laws of the State of Washington. The Link-Belt Company, Chicago, and Dodge Mfg. Company have for some time been parties to a reciprocal purchase of products used in large installations of elevating, conveying and power transmission equipments. The Link-Belt Company has maintained a branch at Seattle and Dodge Mfg. Company at Portland. Both companies will abandon their branches at Seattle and Portland, the new corporation having its main offices in Seattle with an extensive branch at Portland. Full stocks of the products of both concerns will be carried at each point and in all probability at Juneau, Alaska.

The Industrial Commission of Ohio is to hold an industrial safety exhibition in Columbus, Ohio, January 13 to 16 inclusive. The United States Steel Corporation, the Julius King Optical Company and the International Harvester Company are among the exhibitors. Victor T. Noonan, Columbus, Ohio, is director.



Cross-Section of Table C and Lifting Apparatus, Central Steel Company

The Making of Men, Motor Cars and Profits

(*Continued from page 41*)

of proximity of operations is carried to the packing of the parts in boxes for shipment to assembly branches. The gears, for example, are no longer sent from the machine shop to the stock room to be packed for shipment, but are boxed right on the machine floor as they come covered with oil from the machines.

In the same manner annealing furnaces have been built near the drawing presses. A sheet is squared in a shear; a belt conveyor carries it to a blanking press; a second belt takes it to the first drawing press; it slides down a chute to another press for redrawing; another chute delivers it to the annealing furnace; it is returned to the next drawing press and thus to the finishing operation without having been carried by hand one foot of the way.

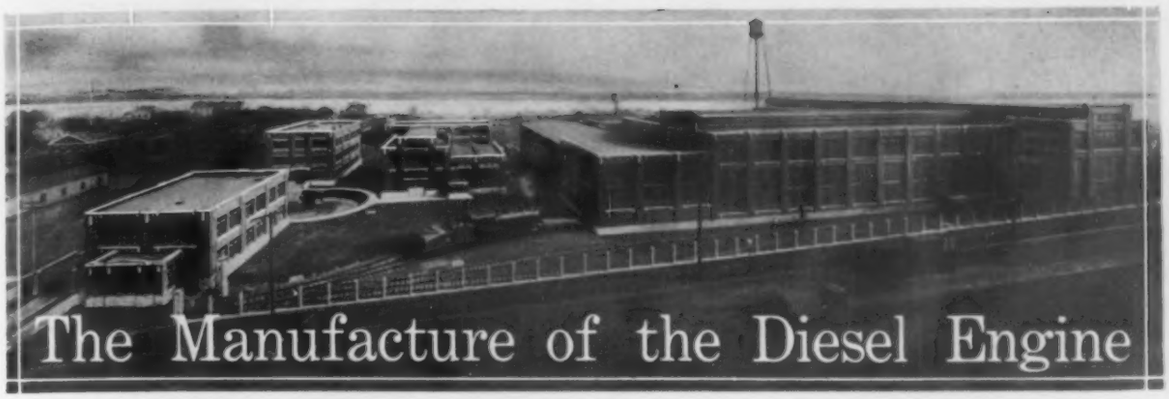
Similarly the running board step is cut from the sheet, drawn through a forming roll, stamped, washed, dipped in enamel and delivered to a continuous chain conveyor which carries it slowly up in a vertical drying tower and returning downward delivers it finished at the opposite side. The tower is inclosed in sheet metal, is heated with an open gas burner, occupies a floor space about 3 by 5 ft. and in every way meets all the requirements of the ordinary enameling oven, which occupies many times the floor space and is not at all adapted to continuous mechanical handling.

The most striking of the new tools developed in the past year are shown in the several accompanying illustrations and their general purposes are indicated in the descriptive captions. The tendency in the newer tools appears to be very markedly toward vertical rather than horizontal machines, wherever the character of the work permits. They have the marked advantage of occupying less floor space, while the operator is able to handle the work in the machine more easily. The newer machines are being built to stand up under higher cutting speeds and a larger number of simultaneous operations. The metal turning machines and the flywheel machines are being equipped also with devices for kicking up the speed of the cutting tool return, a device similar in function to the rapid return of a planer table. This speeding up increases the capacity of the machines shown at the top of page 40 from 322 pieces per day to about 500. Thus in a thousand other forms is manifested the same thoroughly practical ingenuity and initiative but perhaps even more interesting is the fact that other plans, other methods of manufacture and other tools are now in the planning which promise for the next year mechanical accomplishments of even more revolutionary character.

Pattison & Bowns, 1 Broadway, New York, have an inquiry for a large quantity of wire clippers suitable for cutting very heavy wire. They desire from manufacturers printed matter and lowest prices for large quantities, f.o.b. either factory or New York City.

The Wagner Electric Mfg. Company, St. Louis, Mo., announces the opening of a sales office in the Pioneer Building, St. Paul, Minn., in charge of C. Kirk Hillman, who for some time has been identified with the sales of Wagner apparatus in that territory.

The Foster Bolt & Nut Mfg. Company, manufacturer of machine, carriage and stove bolts, lag screws and rivets, Cleveland, Ohio, is distributing an oxidized ash tray, made of stamped metal in an artistically embossed pattern.

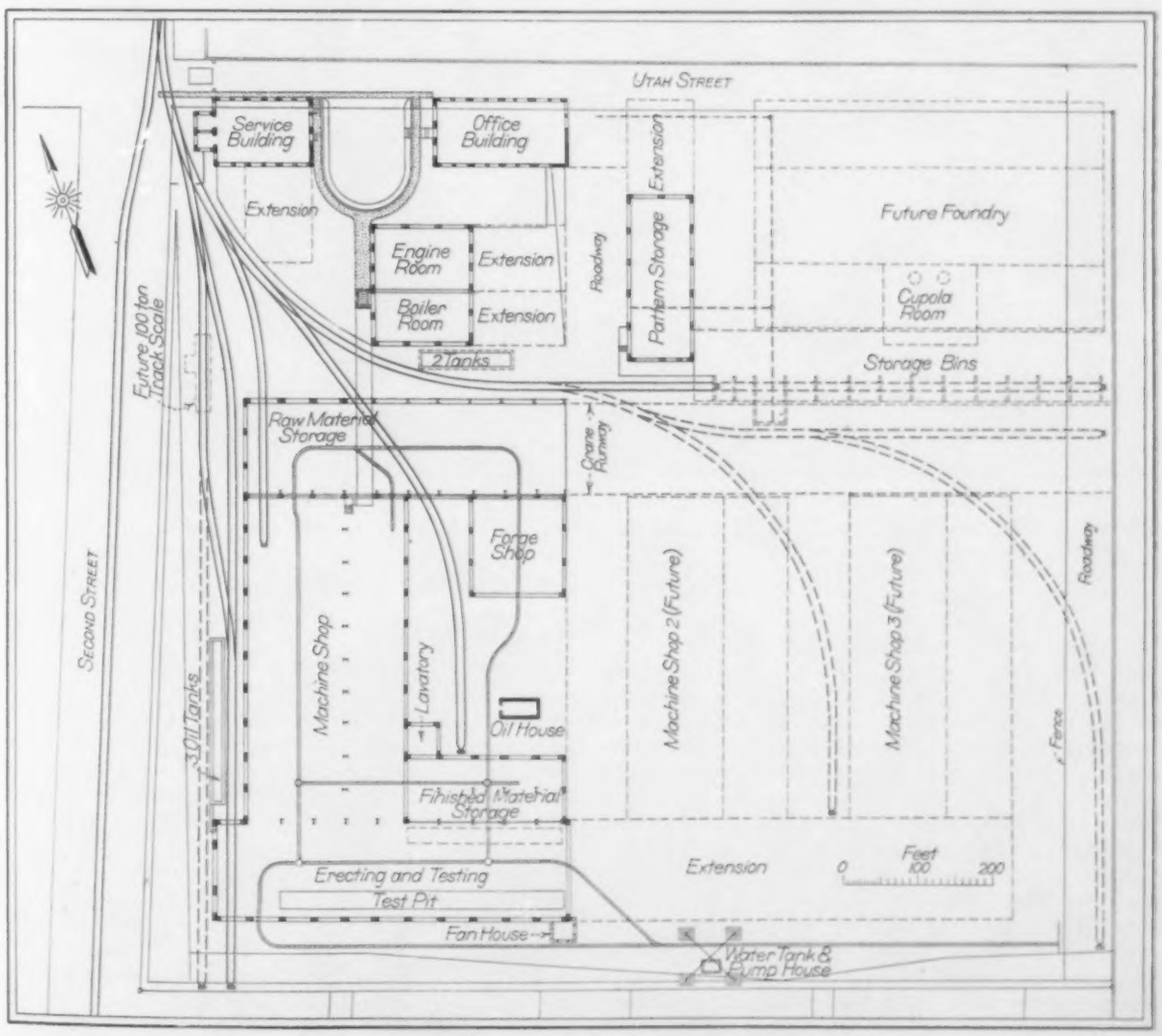


The Manufacture of the Diesel Engine

Some of the Production Processes and the Plant of the Busch-Sulzer Bros.-Diesel Engine Company, St. Louis

BY O. J. ABELL

IN the long run a manufacturing plant will be judged both as to buildings and machine equipment according as it contributes to the successful manufacture of a company's product. Very properly a manufacturing plant may be in a degree a monument, but first it must be a practical workshop. The works erected by the Busch-Sulzer Bros.-Diesel Engine Company in St. Louis, have already been variously described as of unusual lasting and costly construction, elaborate in their detail. In many respects they are deserving of much complimentary description. But the plant, in operation for the better part of a year, may now be considered in a somewhat different light, for until the manufacture of the Diesel engine had been established upon a production basis the really profitable suggestions obtained from the plant, having to do with methods of manufacturing a distinctive type of



The Present Works and the Scheme for Future Extension

power unit and the manner in which the plant harmonizes with these manufacturing operations, were of course unavailable.

THE SCHEME OF THE WORKS

The ultimate plan for the works of which the present buildings are the first unit is illustrated in the accompanying drawings. The eventual layout is of less importance than the present plant, for the test of merit of a unit scheme of plant extension lies not so much in the final arrangement as in the efficiency and adaptability of each unit. The unit plan provides in brief for a crane-spanned storage yard for raw and semi-finished material at the north end, from which, at right angles, the machine shop extends to the erecting shop, which, at the south end, parallels the raw material yard. The continuous extension of storage yard and erecting shop, coupled with a duplication, on parallel axes, of the machine shop unit connecting them, and the inclusion of isolated forge and foundry buildings, constitutes the plan of enlargement. Thus it will be possible to separate the diversified machining operations required for the large number of different engine parts, meanwhile maintaining at a common minimum the distance through which the materials must be handled in moving from storage to final assembly.

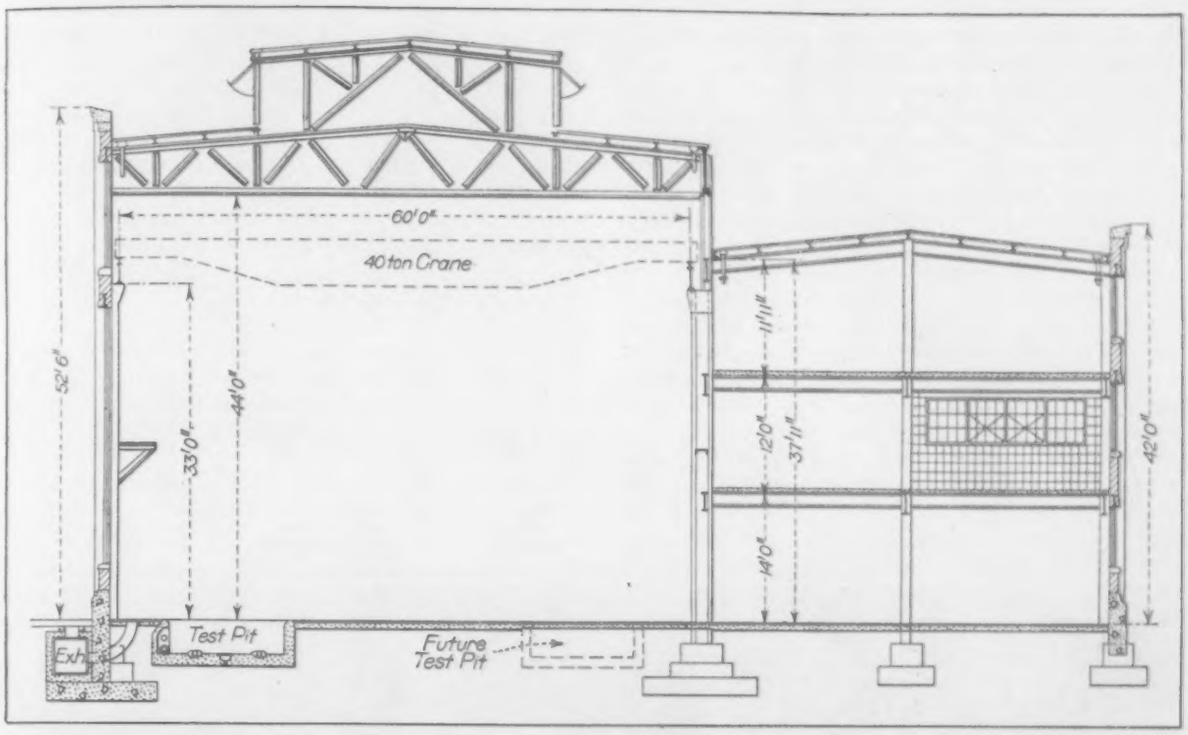
The location of the forge shop and that provided for the future foundry have been arranged with a view to the accessibility of the storage yard facilities. For protection the storage yard is enclosed at one end and roofed over its entire length. It is traversed by standard-gauge track from the railroads serving the plant and by industrial tracks connecting the yard with the shops. The storage yard, the main bay of the machine shop and the erecting shop have a common span of 63 ft. A 30-ton crane in the storage yard, a 30-ton crane in the machine shop bay, a 40-ton crane in the erecting shop, together with the industrial tracks supplementing them, comprise the primary facilities for handling materials. In the smaller bay of the machine shop a crane of 7½ tons capacity is installed for handling the lighter work of that bay. Referring in passing to the adoption of a common span for the several runways, it is worthy of comment that by this device a substantial economy in the cost of roof structure and crane equipment is secured.

THE MANUFACTURING PROBLEM

As a manufacturing problem the building of the Diesel engine involves the handicap of a wide variance in the tonnage going through the shop, resulting either from the run of engine sizes or volume of business. It presents also the difficulty of a large number of different parts. Many of these parts, particularly the smaller ones, involve nothing more than the ordinary machine operations without any special treatment except that all finished sizes are kept within unusually narrow limits of variance. Aside from such more or less commonplace operations, the manufacture of this engine embraces certain principal jobs, the handling of which is illustrative of the nice manner in which the entire engine is built. These principal parts include the bed plate, main bearing boxes, crank case, cylinder and liner, cylinder head, piston and rings, connecting rod and crank-pin box, the admission and exhaust levers and the main shaft gearing. The important feature in all the work is that each part is machined to make it interchangeable. This interchangeability means exact duplication through the development and use of accurate fixtures and the complete machining of every part independently of the particular engine into which it is to be assembled.

From this general survey of the problem in

Bed Plate Set Up with Boring Bar on Newton Horizontal Boring Tool for Machining Main Bearings. A Portion of the 27 x 54-Ft. Setting-Up Table is Shown



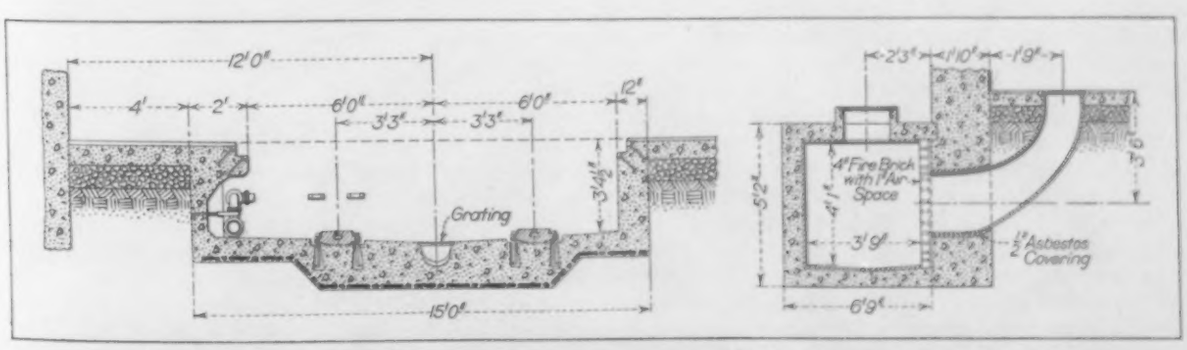
Cross-section Through the Erecting Shop

hand a basis is outlined upon which to consider the general arrangement of the shop tools in their relation to the work to be done. The main bay is the principal thoroughfare for the movement of the essential engine parts in process from stock to assembly. Beginning at the rough material end it is flanked on the one side by the planer group, consisting of six tools ranging in size from 10 x 10 x 20 ft. to 36 in. x 36 in. x 10 ft., and including a planer type Ingersoll milling machine. On the opposite side of the bay the vertical boring mill group, ranging from 146 in. swing, 96 in. under the tool bars and 66 in. bar travel to 54 in. swing in four sizes of Niles boring machines, complete the primary metal cutting equipment.

Auxiliary to this group and immediately preceding it in the matter of location is a layout table 9 x 18 ft., upon which the castings are checked roughly before machining and are laid out for subsequent drilling after being faced. Direct-current, variable-speed individual motor drive was adopted for all tools throughout the shop, and on the planing machines includes, in addition to the reversing motor drive, motors for raising and lowering the cross-rail and for the rapid traverse of the heads on the cross-rail.

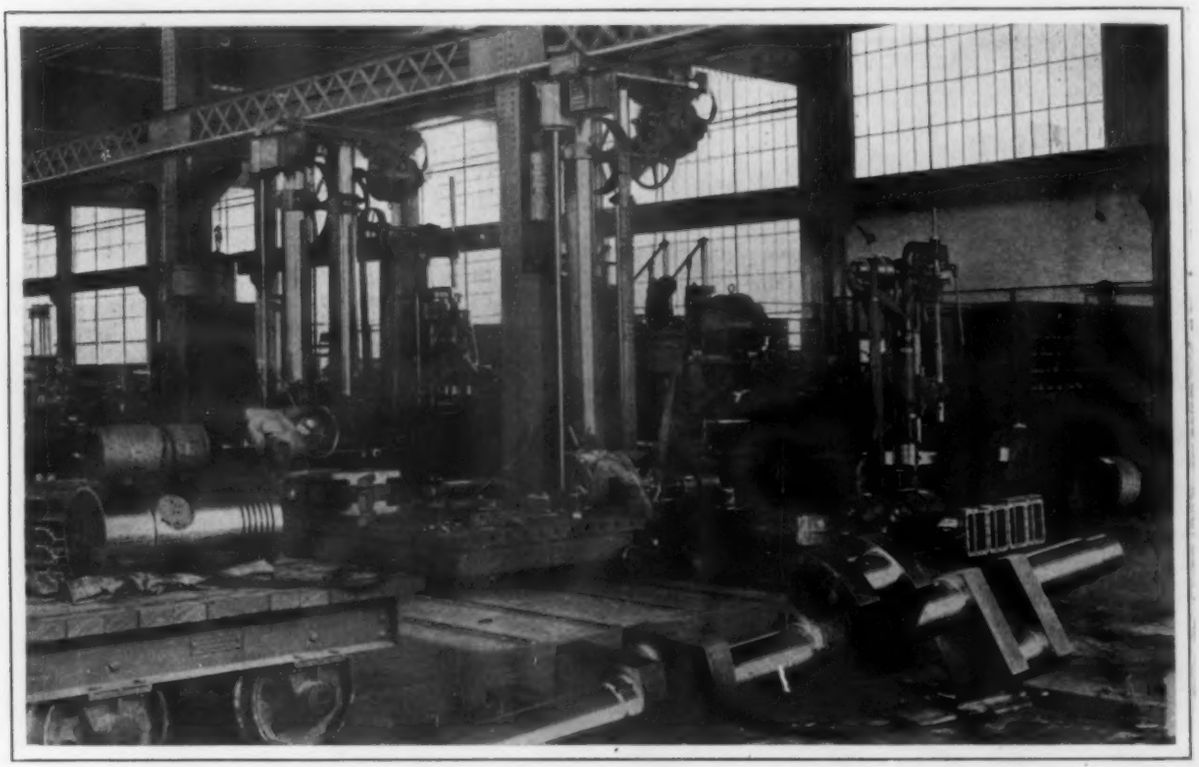
The planing machine group is followed by the drilling equipment, which includes the usual upright and radial drilling machines, but of which the interesting features are three Pawling & Harnischfeger horizontal drilling and boring machines. The wide range of work brought to these tools and their adaptability, enhanced by the use of a setting up table mounted on trucks, will be more fully illustrated. On the opposite side of the bay are the heavy lathes with capacity ranging up to 60 x 25 ft., and between the lathes and boring mills a Lucas precision horizontal boring tool.

For the convenient machining of castings so large as the bedplate and crank case, upon which a number of dissimilar operations are to be performed, an arrangement permitting the free handling of the casting is most desirable. Supplementing this there should be provision for easily securing a rigid set up of the casting in any position and in accurate alignment. For this purpose a floor plate 27 x 54 ft. with standard T slots in both directions on 12-in. centers was laid flush with the floor. This cast-iron plate is built in sections 9 ft. square, planed to a true surface and bolted together. The plates were accurately leveled on supporting screw jacks, with a permanent support of concrete beams with thin cement grouting. The screw jacks are left in place for subsequent adjustment of the plate level in case of necessity. On this floor plate are mounted a heavy duty 6-ft. Bickford radial and Newton horizontal boring, milling and drilling machine with a 54-in. spindle travel, a 96-in. vertical adjustment and a horizontal column movement of 120 in. There is also a 24-in. Dill slotter.



Details of Test Pit, Indicated in Cross-Section Above, and of the Duct for the Engine Exhaust

The lighter machining operations for which the side bay machine tool equipment provides, are for the most part those ordinarily involved in the working up of bar stock, sleeves and bushings, the finishing of small forgings, the cutting of gears and the grinding of shafts and pins. The machining of the piston rings and the working up of the admission and exhaust levers are processes more special in their character. But by the character of the tools in this bay perhaps as much as by any other feature of the plant equipment, the essential purpose to secure accurate machining of all work is indicated. To the battery of medium size engine lathes, three turret lathes are coupled for rapid production of duplicate parts using special jigs. For the piston rings a Niles vertical turret lathe is grouped with a Bullard and a Blanchard disc grinding machine. For the other grinding there are a number of Norton grinders, including a specially designed 120-in. machine for grinding the pistons and a Heald internal grinder for grinding Hartinell bushings, cam



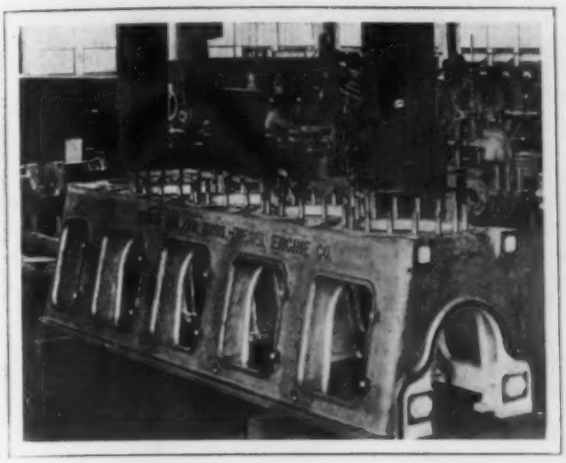
View of Pawling & Harnischfeger Drills with Which a Wide Variety of Work is Handled

rollers and similar pieces. The gear cutting machines include a Plauter hobbing milling machine and a Fellows gear shaper and for bar stock and chucking work the equipment provides Jones & Lamson flat turret lathes and Gridley automatics.

The preface to all machining operations is an unusually rigid inspection of castings and forgings as they are received. Before they go to the machines, the castings must be free of all surface fins and dirt, special emphasis attaching to the cleanness. Consider first the bedplate. Immediately following inspection it is mounted bottom side up on the large planer, rough faced and finished, then turned over and set up on ground parallels. The top is then planed for the crank case flange and the main bearing caps, in exact parallel with the bottom. Before the bed is taken down from the planer, longitudinal center lines are tool marked on the casting for the locating of the jig from which the bedplate bolt and tie rod holes and the main bearing stud bolt holes are drilled.

The drilling of these holes, some of which are 3¾ in. diameter, brings into service the heavy duty Bickford radial drilling machine and the floor plate described. At this time the main bearing stud bolt holes are tapped, temporary studs inserted and the bearing caps bolted down preparatory to the boring of the main bearings. For this boring job, the piece is moved over on the plate to the Newton machine, where an interesting boring bar set up has been devised for finishing the bearings. The standard bedplate has five bearings and the bar is centered with a steady rest in each bearing, as illustrated in one of the accompanying cuts. The steady rests having supports machined to fit accurately upon the previously planed sides of the bearing. One steady rest is then removed at a time and a boring head substituted with which the bearing is rough bored and finished. After all the bearings have been bored, two heads are mounted on the bar for facing the ends of the bearings. Both ends are roughed simultaneously, but in the interest of accuracy only one end is finished at a time.

During the operation of boring, the crank case is bolted on the bedplate and the end bosses of both milled off with an end miller. The castings are then turned end for end and the opposite bosses finished. This done the two castings are picked up and taken to the Pawling & Harnischfeger horizontal drills. Here the work is set up on the worktable car for the drilling of the end flanges. These cars have a table area of 6 x 8 ft. and run on standard gauge tracks, the rails of which are very accurately leveled. To prevent the over-balancing of the larger castings a third rail is laid, permitting the support of the work on a foundation of wider gauge. The table cars have a hand adjustment along the track permitting an accurate setting of the work to centers. The bedplate is then taken to the erecting floor, where the bearings are scraped and tested with a special arbor for size and contour and made ready for receiving the main bearing shells. As indicated in the view of the bedplate and the crank case as well, the interior surfaces are given a coat of aluminum paint as a precaution against dirt.



Typical View of the Diesel Engine Crank Case for the Larger Units. Exceptional Care is Necessary in Casting Because of the Thin Metal Section and the Possibility of Warping

The temporary studs are then replaced with permanent studs 1¾ in. diameter with fine threads.

The finishing of the main bearings further illustrates the manner in which the machining processes have been devised to insure interchangeability. Cast in one piece, the bearing shell is rough turned to within 1/16 in. of finished size on the Bullard or Niles vertical turret lathe, following which it is bored and dovetailed for babbitting. It is then sawed in two on the Ingersoll milling machine and taken to the forge shop for babbitting. Before pouring the babbitt the bearing shell is heated to retard the cooling of the babbitt sufficiently to permit the escape of all air and moisture as well as to permit the shell and babbitt to shrink together. As a result no peaning of the babbitt is necessary to insure the tightness of the bearing metal. The shells are then locked in a V-block fixture two at a time and the faces accurately milled on the Ingersoll miller.

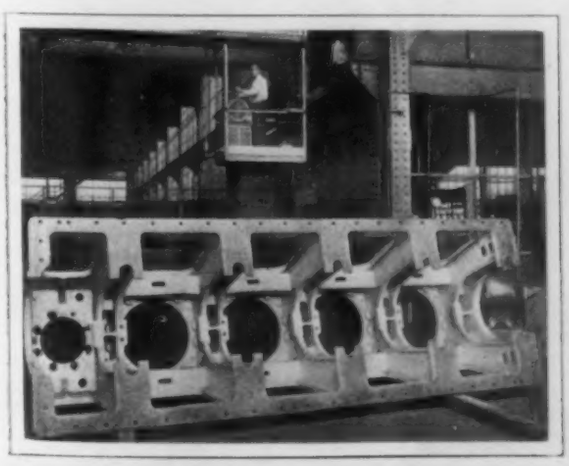
To establish the interchangeability of the bearing shells the lower half is drilled through a jig for four dowels and the top half drilled in the same manner. The top and bottom shells are clamped together in a V-block with the dowels set in place and are bored out on the Lucas horizontal machine with proper allowance for shims. They are then clamped on a mandrel and turned and faced to size. The half shells are mounted in turn on a universal milling machine for cutting the circular oil groove in the babbitt, the work being done with an end miller as the shell rotates on a turntable. The shells having also been drilled for the oil hole and torsion dowel, are bedded into the bearing seat in the bedplate and the babbitt scraped for the shaft bearing. For working down the bearings the crank shaft is painted with soluble blue, as the thinness of this coloring makes it a much more sensitive indicator than red lead.

The cylinders are taken to the large boring mills for the first operation. They are given a roughing cut on one end with facing and boring tool. The cylinder is then turned upside down and the opposite end roughed and finished. The casting is again reversed with the finished end down and fitted on a centering jig. Correct alignment is thus certain of attainment in the finishing of the other end. The gallery pads on the side of the cylinder are planed, following which the cylinder is taken to the heavy Bickford radial drilling machine, where the end flanges are drilled and tapped in fixtures.

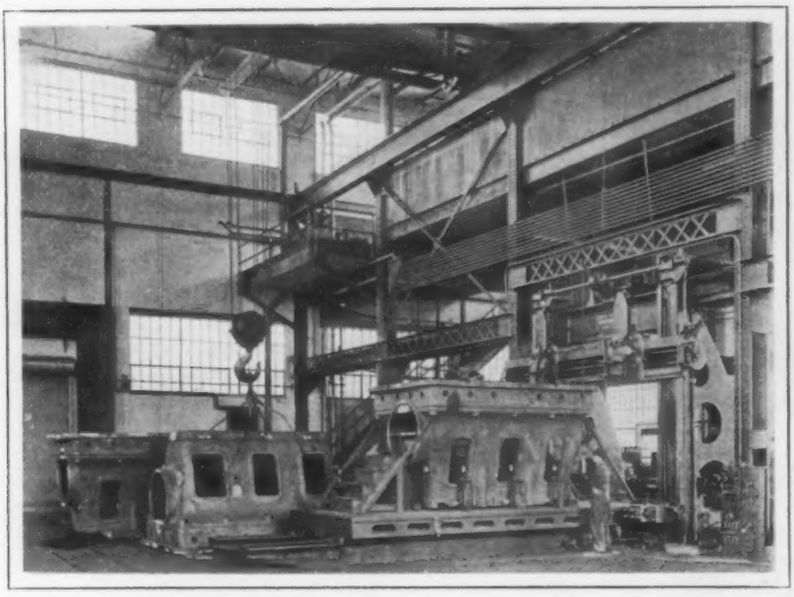
The cylinder liner is inserted and drilled in place with the cylinder shell. The cylinder studs are very heavy and have an unusually fine thread, making it advantageous to set the cylinders over conveniently to the P. & H. drills where the studs are screwed in with the drill spindle. The cylinder liners are fitted with centers for rough turning on the outside in a 42 in. lathe. They are taken to the Newton boring mill for rough boring, the liner being locked in special steady rests on the floor plate. Before being finished the liner is given an hydraulic test, after which it is again set up and finish bored with a special finishing cutter.

The Finished Bed Plate Ready for Assembly. In the Background is a Cylinder in Which the Heavy Studs for the Cylinder Head Have Been Set with One of the Pawling & Harnischfeger Drills

The process of machining the cylinder heads also involves the use of a number of tools and fixtures in an interesting way. The top and bottom faces are machined on a boring mill in a manner similar to that described for the cylinders. The lower face is then drilled and reamed for dowel holes by means of a jig, these holes serving to locate the head properly on a centering jig mounted on the boring mill table. The dowel pins in this centering jig align the cylinder head just as though it were placed on the cylinder itself. The cylinder head is so set up in preparation for the boring of the ports for receiving the admission and exhaust bonnets. These ports requiring to be bored off the center are located in proper relation to the boring tool by the eccentric of the fixture with relation to the boring mill. For boring these ports special cutter heads are used, the one roughing and the other finishing, the heads being mounted on special bars one end of which is fitted to the ram of the boring mill while the lower end, running in hardened bushings, acts



Another View of the Crank Case



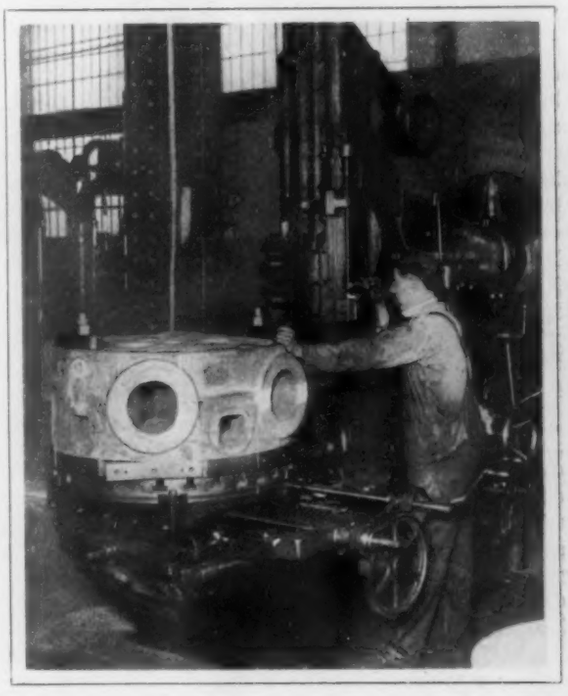
Crank Cases Mounted on Planer for Machining

as a guide. One port having been bored, the head is turned half way around and the second port similarly finished. The boring of the fuel and starting ports is accomplished in like manner.

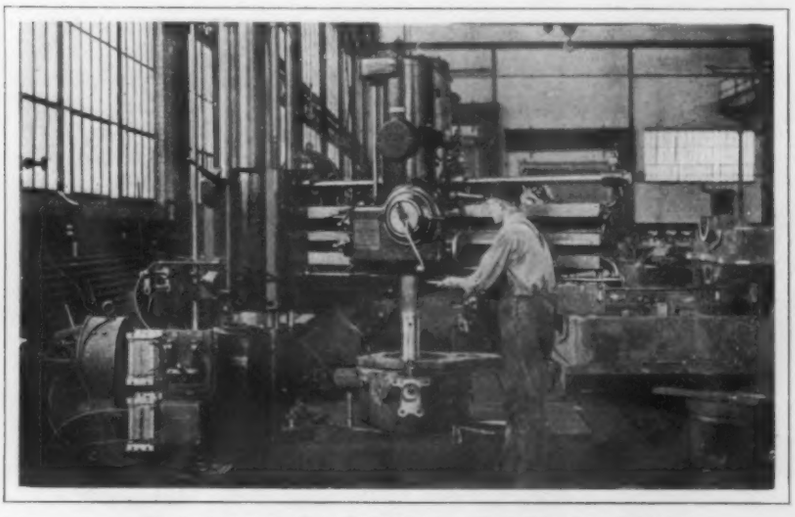
The finishing of the numerous bosses on the outer surface of the cylinder head to which exhaust elbows, inlet elbows and water by-pass brackets are bolted, follows. For this purpose a flat plate jig has been made having dowels for the accurate locating of the cylinder head upon it. The periphery of the jig is machined with faces corresponding in location, angularity and radius from the center of the jig, to each of the bosses to be machined on the surface of the head. By means of these faces on the jig it is possible, when the cylinder head is set up on the slotter for facing the bosses, to determine quickly the correct distance and angles by running the cutting tool up against the jig for distance crosswise for the angle.

Having established the proper angle for the first face, the other angles can be obtained by simply rotating the table of the slotter. For the drilling of the top and bottom faces, the cylinder heads are taken to the heavy Bickford radial, the drill centers being located by means of a jig fitted into the same dowel holes used in the preceding set-ups. The holes in the side bosses are drilled from the P. & H. drilling machines, the head being mounted with the fixture above described on a turntable on the table cars already mentioned.

Special processes have been devised for machining the pistons. The outer surface is finished, turned and grooved in a standard engine lathe with 0.018 in. allowance for grinding. The centers upon which the pistons are set up in the lathe are taken from the inside of the piston shell, so that when finished the inner and outer lateral surfaces will be absolutely concentric, or in other words, the piston shell will have a uniform thickness. The piston is then chucked and locked in a steady rest and counter bored at the open end for a grinding center. At the same time the bosses on the inside of the piston for the connecting rod pin are faced to



The Finished Faces on Periphery of the Fixture Correspond in Angle and Location to the Bosses on the Casting

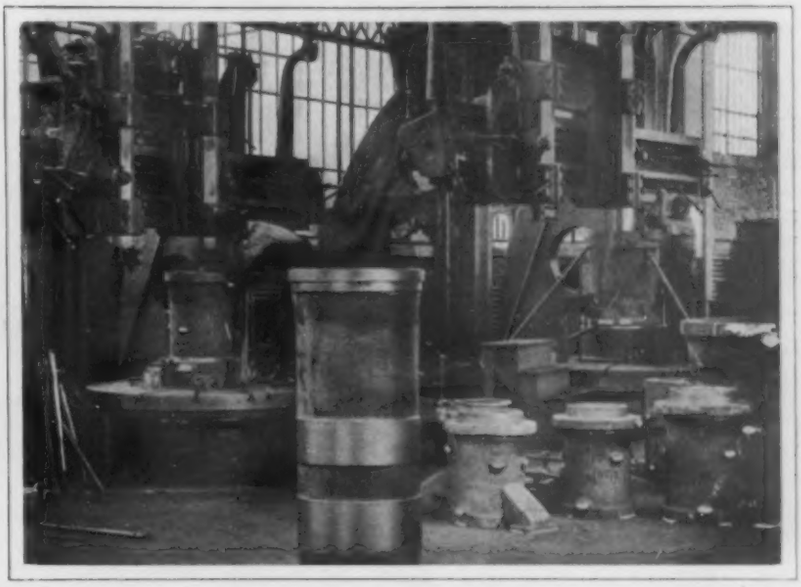


Heavy Duty Bickford Machine Drilling Cylinder Head

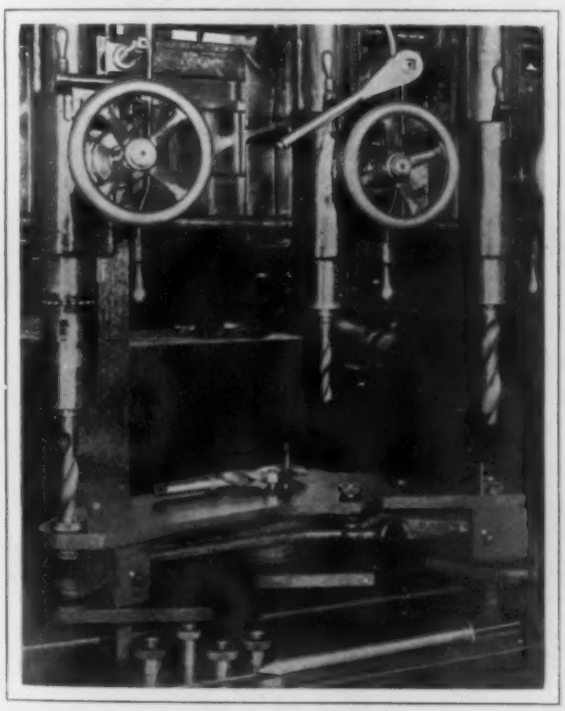
a radius equal to the desired distance for these boss faces on either side of the center line of the connecting rod. The face of these bosses may then be subsequently squared very easily to this distance on the boring mill at the time the piston pin holes are bored. The essential feature in the boring and reaming of the taper holes for the piston pin has to do with the securing of an exact right angle alignment of the piston pin with the center line of the connecting rod. To this end the piston is centered in a special V-block jig on the boring mill and the taper hole bored and reamed. The piston is then drilled for water circu-

lation, a delicate operation involving the drilling of two holes 1 11/16 in. in diameter and 34 in. deep. The piston is then finished on a Norton grinder.

The piston rings are cut from a cast-iron blank the surface of which is rough finished on the Niles vertical turret mill. The rings are cut off on the Bullard machine and the flat faces ground to a finish on the Blanchard disc grinder. To split the rings they are milled on a special clamping device half on the inside and one-half on the outside, severing the ring at the junction of the two recesses. The rings are pulled together and pinned and a number are clamped together and the pile rough-bored and turned on the Bullard. They are then taken apart and forced over an arbor of the exact piston diameter. Again they are pulled together at the joint and pinned and turned to the finished outside diameter size. They are finally piled in a jig and bored.



Machining Cylinders and Liners on Large Boring Mills

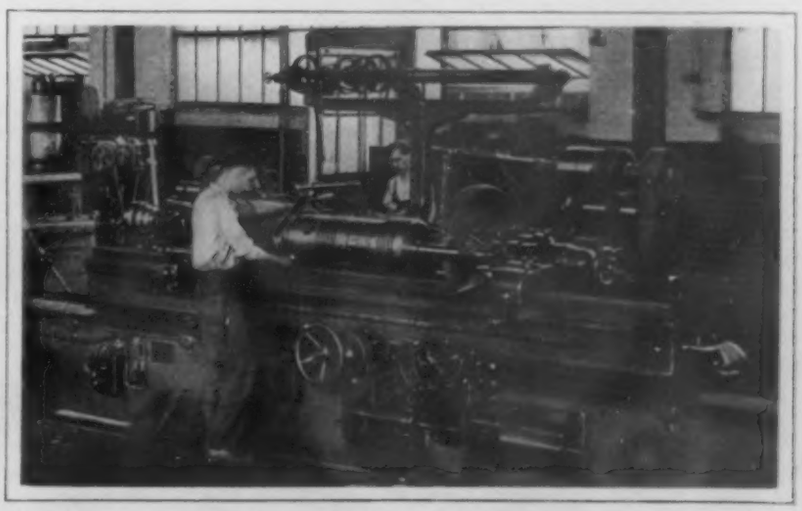


Detail View of the Exhaust Lever Locked in the Drilling Fixture

The connecting rods are received from raw material stores rough turned, and before being further machined they are checked up to determine whether sufficient stock has been left for finishing. The crank pin box is separate from the connecting rod. Before removing any stock from the rod it is drilled for a ¾-in. oil hole which runs through the full length of the piece—about 48 in. in the largest sizes. If a drill should break in the hole, necessitating the heating up of the piece, such warping as might possibly ensue could still be removed through the subsequent machining, an impossibility if the forging had been previously worked down to finished size.

The rod is turned and faced to finish size in a 42-in. engine lathe. The flat faces of the rod are then planed, in which operation precaution is taken to preserve the proper balance of the rod and the exact paralleling of the faces by blocking it up in a centering jig on the planer. When one side is roughed out the rod is rotated for roughing and finishing of the opposite side, then back again to the first side for finish. The face of the connecting rod to which the crank pin box is bolted is countersunk for the dowel which centers the crank pin box in position. By means of a collar gauge inserted in this dowel hole the setting of the tool for planing is accurately determined.

The opposite end of the connecting rod comes roughed out for the piston pin bearing box. This open end is finished on a slotter to within 0.003 in. of finished size, this stock being left for working down to a hand scraped fit. The P. & H. drills are again called into service for drilling and reaming the holes for the crank pin box holding bolts, these holes being located from a jig centered in the dowel. The rod is then locked in a steady rest on an engine lathe and drilled and counterbored in the piston end, for the pressure plate and adjusting screw.



Pistons Are Ground for Finish on Specially Designed Norton Grinder

Machining of the crank pin boxes is also typical of the methods employed at this plant. The box is first centered, turned and faced in a 42-in. lathe. It is then set up on an upright drill where with a jig for accurately locating them, the two principal bolt boles are drilled and tapped to a depth of about 2 in. The piece is now taken to the boring mill where it is set up in a special fixture which carries the box on centers and locks the piece in position by means of two plugs fitting into the bolt holes partially drilled.

The box is then bored out with a roughing cut from one side, is turned over, bored and faced from the opposite side, and dovetailed for babbitting. It is then split, tinned and babbitted, after which the boxes are planed on the joint faces. Returned to one of the heavy drills the box is then drilled through for the bull holes 1/16 in. under finished size. These holes are then reamed twice, the first reamer taking out 1/32 in. and the second reamer finishing. They are then drilled for dowels with a jig to receive the shims, when they are fitted with bolts and shims in place and bored and faced to finished sizes. A circular oil groove is milled in the bearings, the oil hole drilled through from the outside and the box is ready for working down the bearing on the crank pin.

FACILITIES OF ERECTING SHOP

Although the exceptional accuracy in machining processes reduces to a minimum the amount of fitting necessary during assembly, the same care is observed in putting these engine parts together. Very complete assembly facilities are provided in the erecting shop. In addition to the main crane there are three 5-ton electric wall cranes overhanging the testing pit in which the engines are erected. This testing pit is 12 ft. wide and 199 ft. long. The pit has a depth of about 3 ft. 6 in. below floor level. In it are laid water mains with outlets at frequent intervals, from which water may be obtained for pressure tests or brake horse-power tests. The floor of the pit is arranged to drain the water and flues are provided for carrying off the exhaust gases from the engines running under test. Pipes conveying the fuel oil for the engines from the storage tanks are also laid in a protected position in this testing pit.

The Diesel engine is naturally fitted for many kinds of service which perhaps more generally involve an isolation of the plant from easy access to repair parts or which place a greater premium upon continuous operation than is commonly true of other types of power units. Merit in this particular engine rests very largely therefore upon the character of workmanship entering into its manufacture.

The shop processes of manufacture described are simply representative. They are presented both for their interest in the abstract as typical methods of engine building and also as being in a degree illuminating with regard to the mechanical qualities likely to be demonstrated in operation. As illustrating the adaptability of the Diesel engine power plant to general industrial purposes, attention may be called to the installation which furnishes power for this company's own shop. There are three principal units of the Diesel four-cycle of 225-hp., each direct connected to 160-kw. Crocker-Wheeler direct-current generators. The engines are of the vertical, three-cylinder design 16 x 24 in. in size, and at full load are capable of developing a brake horse-power hour on less than ½ lb. of oil, equivalent to about 9000 B.t.u. Upon them the operation of the plant is continuously dependent.

New Jersey Zinc Company's New Lithopone Plant

Several months ago the New Jersey Zinc Company, 55 Wall street, New York, broke ground for the construction of a new Lithopone plant near its oxide plant at Millport, Palmerton, Pa. It occupies a plot approximately 400 x 600 ft. A dozen buildings will be erected, some of them of considerable size. Several are constructed of steel and concerete, others of brick and still others of frame, depending upon the use to which they are put. It is expected that the new plant will be in operation about April 1. The company began to manufacture Lithopone about 10 years ago, and has perfected its methods to such an extent that the demand for New Jersey Lithopone has grown so large as to demand an output which could not be made by further enlargement of the old plant. Lithopone is a white powder which is used largely in the manufacture of paints, particularly the sanitary flat wall finishes which are finding so great application in interior housework. It is also much used in the manufacture of high class linoleums and oilcloths, forming a flexible compound which resists cracking. In addition, its use in rubber compounds is continually increasing.

Cleveland Crane Bonus System

Employees of the Cleveland Crane & Engineering Company, Wickliffe, Ohio, have received checks representing a share of the profits of the year distributed as a bonus for faithful service. This system has been in vogue with the company about five years. It is figured on the percentage basis. Under it, 3000 hours is taken as a year's work and to each employee who has not been absent from his work more than one day of each month during the year 1 per cent. of his yearly wages is paid for each full year that he has been in the employ of the company. A man who has been with the company five years thus receives 5 per cent. of his yearly wages. The mutual benefits of the system for both employer and employee, officers of the company say, are inestimable. The majority of the employees were eligible for benefits this year.

H. Koppers Company Reorganization

At a recent meeting of the stockholders of the H. Koppers Company, A. W. Mellon, R. B. Mellon and H. B. Rust, all of Pittsburgh, Pa., were elected members of the board of directors and, with Heinrich Koppers, of Germany, and James C. McMath, of Chicago, constitute the board. Mr. Rust was elected president of the company. Mr. Koppers retains a large stock interest and will give the company the full benefit of his technical knowledge by serving as consulting engineer. This arrangement will permit him to devote more time to his foreign interests without injury to the American business. James C. McMath will continue as vice-president of the company. The general offices will be removed in the near future to Pittsburgh.

The Wisconsin Trust Company, Milwaukee, trustee of the defunct Wisconsin Engine Company, Corliss, Wis., has filed a report recommending that the property be abandoned because it is impossible to interest capital in the purchase of the plant and equipment. Several months ago the property was sold for $120,000, but the sale was set aside by Judge F. A. Geiger of the United States District Court because of irregularities. The trustee states that investors will not even visit the plant to investigate. The First Trust Company, Milwaukee, notified the referee in bankruptcy, following the filing of the trustee's report, that it is about to foreclose a $150,000 mortgage.

The University of Tennessee, Knoxville, is arranging, in co-operation with the Tennessee Manufacturers' Association, to establish extension courses in manufacturing in six of the largest cities of the State. Employees of manufacturing concerns will then have an opportunity to study engineering and technical work in connection with their employment.

A Bonus System of Comprehensive Scope

Plan of the Reed-Prentice Company, Applied to Both Foundry and Machine Shop and Differentiating Workmen and Machines

BY JOHN NELSON

The Reed-Prentice Company, Worcester, Mass., has developed and installed in its machine shops and foundry a bonus system which in the one year of its operation has demonstrated its power to improve greatly the efficiency of the works and at the same time to increase materially the earning power of the employees. The system possesses an original combination of features. In the first place a differential is created among workmen, based on their wage rates. The higher paid man is allowed less time for a given task than one who has a lower wage rate. Also there is a differential between machines. For example, if work requires a heavy cut the standard time, upon which the system is based, is greater for an ordinary cone driven lathe than for the more powerful geared head machine. Comparisons of cost of production among the various elements of equipment are easily obtainable, and such exact knowledge is vital, if a high degree of works efficiency is to be obtained and then maintained.

The introduction of the bonus system in the machine shop soon showed up tools which were under the limit from a production standpoint, and these have been built over or replaced by the latest models. Comparisons of methods constitute another value of the system. These factors combine with others to maintain a high degree of general shop efficiency, which means money saved.

Each man has his hourly wage rate, which is assured him, regardless of bonus. It represents his skill; the quality of his work. The bonus he earns stands for the quantity that he produces of the given standard of excellence.

The system has stimulated the most active and ambitious co-operation on the part of the foremen. A chart of efficiency is maintained for each department, and every week each foreman receives not only a report of his department efficiency, but also a report of the individual efficiency of his individual men. The Reed-Prentice Company has been taking on of late a large number of additional workmen, and the active interest of the foremen has been demonstrated by their anxiety to take personal part in selecting the new mechanics for their departments in order that the best possible material may be assured them.

Each foreman signs all wage tickets of his department, which is considered important because to do so brings him in close touch with those under him and with their labor and remuneration and efficiency under bonus. The efficiency of a department, reckoned in percentages, depends upon the individual efficiency of its employees, and the latters' efficiency is dependent upon their wage rates, since the time each is allowed for a given job is graduated by his hourly rate. Therefore the foreman's direct advantage is to gauge his new men according to their capabilities, rather than with the purpose of obtaining for them as high a wage rate as possible through a feeling of good fellowship. Furthermore, it is to his interest to assign work to the lowest price man possible, compatible with the task. The fact should be kept in mind that the average foreman, especially the older man, is usually ignorant of modern methods of manufacturing, until incentive and instruction come to him as they do under a system such as this.

THE MACHINE SHOP BONUS SYSTEM

An analysis of the system as applied to the machine shops follows:

1. Every bonus job has a standard time and a base rate for it.

The standard time is the time allowed a workman whose rate is the same as the base rate, and is the time within which he should complete the job.

2. To equalize the chances of more or less experienced men in making bonus on a job the following allowances on the standard time are made:

The time allowed a man whose rate is different from the base rate is 2 per cent. more (or less) than the standard time for every 1 cent per hour that his rate is less (or more) than the base rate.

STANDARD TIME RECORD CARD

PATT. NO.	6116-10-1	NAME	Head
WGT.		FOR	16" Heavy Duty Lathe
R. B.	96	OPERATION	Mold & Close for Pouring
DATE	9/30/14		
S. T. per Piece			3½ hrs
Type of Molding			Floor
O. K.			C.J.S.

DETAILS		DETAILS
Kind of Flask	Wood	
Length	3'	
Width	2'	
Depth	2'	
Value of "R"	2.25	
Proper Time	2.80	
Incidentals 25 %	70	
Standard Time	3.50	

Fig. 1—The Standard Time Record Card

ACTUAL PERFORMANCES WITHOUT HELPER					ACTUAL PERFORMANCES WITH HELPER				
DATE	CHECK NO.	NO. OF PCS.	ACTUAL TIME Total	ACTUAL TIME Per Pc.	SCRAP	DATE	CHECK NOS.	NO. OF PCS.	ACTUAL TIME Total	ACTUAL TIME Per Pc.	SCRAP
10.6	185	20	84	4.2	1						
10.10	161	10	37	3.7	-						
10.24	185	10	39	3.9	-						

Fig. 2—Record of Actual Performances on Reverse of Fig. 1

EXTRA OPERATION TICKET

Date

103

ORDER NO.	NO. PCS.	NAME OF PATTERN	PATT. NO.
30,132	30	Head	6116-10-1

CHECK NO.	MOLDER'S NAME	EXTRA TIME
184	J. Smith	15 m (Per Piece / Per Job)

TO TIME CHECKER. PLEASE ALLOW THIS EXTRA TIME TO APPLY ON THIS LOT AND ORDER ONLY.

WHY WAS THIS EXTRA TIME ALLOWED?

Pattern very much worn

HOW CAN IT BE AVOIDED? Fix up pattern

DATE SETTER 9/6 QUIT. W K APPROVED BY C.J.S.

Fig. 3—The Extra Operation Ticket

S. F. Co. Form No. 38
38-10-14

FOUNDRY BONUS TIME TICKET

ORDER No.	No. of Pieces in Lot	NAME OF PATTERN	Pattern Number	Operation	TIME Start	TIME Stop	TIME Taken	S. T. per Piece	No. Castings Made	T. A. on Castings Made
R 359	20	Back Gears	6016-10-15	1	7[00]	2[30]	6½	25[m]	15	6¼
R 478	50	Int Gears	6016-00-76	1	2[30]	3[45]	1¾	15	7	1¾
115A	–	Pouring off					¾			inc

No. of Pieces Scrapped	PATTERN NUMBER	TIME ALLOWED Per Pc.	TIME ALLOWED Total	TOTAL TIME FOR SCRAP		
1	6016-00-76	15	½	¼	Total Time Allowed	8
					Deduct for Scrap	¼
					Net Total Time Allowed	7¾
					Total Time from Clock Record	9

DATE	HELPER'S NAME	Helper's Check No.	MOLDER'S NAME	Check No.
Dec 15/14			J. Smith	184

Fig. 4—Foundry Bonus Time Ticket

For example: A job has set a standard time of 10 hr. and a base rate of 30 cents.

The time allowed a 35-cent man would be (35—30)×2=5×2=10 per cent. less, or 10—1=9 hr.

The time allowed a 25-cent man would be (30—25)×2=5×2=10 per cent. more, or 10+1=11 hr.

3. Standard times apply only on the machine and under the shop and other conditions for which they are set. These conditions are recorded when the time is set. The company agrees not to cut any time, once set, so long as the work to be done, the manner of doing it, the jigs, tools, machine, etc., remain unchanged.

4. A workman's efficiency on a job is the time allowed divided by the actual time taken and multiplied by 100.

5. When a man runs more than one machine his efficiency will be calculated on the number of machine hours spent on each job, not his own hours.

6. The bonus paid will be nothing for 60 per cent. efficiency, 20 per cent. of the regular wages for 100 per cent. efficiency and a proportionately larger or smaller percentage of the regular wages under bonus for other efficiencies.

For example, a standard time of 10 hr. and a base rate of 20 cents is set on a job. Below are given some figures of wages and bonus for a 20-cent man.

Time allowed, hr.	Time taken, hr.	Efficiency, per cent.	Bonus, per cent.	Bonus, dollars	Wage rate (Including regular wages and bonus)
10	17	59	0	0	20 cents per hr.
10	16	62	1	0.03	20 " " "
10	14	72	6	0.17	21¼ " " "
10	12	84	12	0.29	22½ " " "
10	10	100	20	0.40	24 " " "
10	8	125	33	0.53	26⅔ " " "
10	5	200	70	0.70	34 " " "

7. Every man's efficiency will be calculated each week on the bonus jobs he has completed that week and the average bonus made on those jobs will be paid him with his regular wages.

8. No bonus is paid on any work rejected, for any cause. It is therefore to the interest of every workman to see that the material given him is good and furnished to size before he does any work.

9. No bonus is paid on an operation on which the workman spoils 5 per cent. or more of the pieces.

10. Standard times are set with the assumption that the job is done in the best known way and with the proper tools.

The standard time includes an allowance for all necessary setting up and cleaning away, etc. Consequently the time a workman takes on a job is considered to have begun when he finished the job before it, and to have ended when he begins the job after it.

THE FOUNDRY BONUS SYSTEM

The bonus system for the foundry varies in some details from that of the shops, but the principle is the same, except that the wage differential is eliminated, as being an unnecessary complication under conditions of labor as they exist in the foundry. While the system has been in operation in this department only a short time, the results already obtained are important in the way of greater production and greater earnings for the workmen. The tendency to start active effort late, and to cease labor during the period after "the wind goes on" and pouring commences, has largely disappeared. The men are after production and the resultant addition to their pay envelopes, which is the reward of high efficiency.

In the foundry every bonus job has a standard time set for it, which is the time in which a good molder ought to be able to complete the job. A molder doing the work in this time is considered 100 per cent. efficient and receives bonus. The time limit on a job is half as long again as the standard time and is the longest time that a molder should take on the job. No bonus is paid on any job on which the molder takes more time than the time limit.

Standard times apply only for the pattern, match board, stripping plate, etc., and under the shop and other conditions for which they are set. These conditions are recorded when the time is set. The company agrees not to cut any time, once approved, so long as the work to be done, the manner of doing it, the pattern, appliances, general conditions, etc., remain unchanged.

All standard times are set assuming only one molder without a helper. If the molder is given a helper the whole of the molder's time is charged against the job, but only one-third of the helper's. To illustrate this point:

		Wages	Time Worked	Time Charged
Monday:				
Molder	A getting 35c. works 10 hr.	$3.50	10	10
Helper	" 17½c. " 10 hr.	1.75	10	3⅓
Tuesday:				
Molder	A " 10 hr.	3.50	10	10
Molder	B getting 30c. " 10 hr.	3.00	10	10
Helper	" 10 hr.	1.75	10	3⅓
		$13.50	50	36⅔

Time allowed on job 30 hr.

Efficiency 30÷36⅔ (time charged)=82 per cent. Therefore efficiency bonus is 11 per cent.

And molder A receives 11 per cent. of his regular wages, $7, or 77 cents.

Molder B receives 11 per cent. of $3, or 33 cents.

Helper receives 11 per cent. of $3.50, or 39 cents.

A workman's efficiency for the week is the total time allowed on all the good castings he produced during the week, divided by the total actual time for which he was paid for the week and multiplied by 100.

Bonus is paid molders whose average efficiency for the week is 66 per cent. or over. The rate of this bonus will be as follows: For 66 per cent. efficiency, the rate is 3 per cent. of the molders pay for the week; for 70 per cent., the rate is 5 per cent.; for 80 per cent., 10 per cent.; for 90 per cent., 15 per cent.; for 100 per cent., 20 per cent.; for 150 per cent., 45 per cent.; and proportionately for intermediate or greater efficiency.

For example, supposing a man worked 54 hr. in the week and produced good castings corresponding to the table given below:

Good castings	Standard time, hr. Each	Standard time, hr. For the lot
5	3	15
5	3	15
5	3	15
12	1½	18

Total time allowed on good castings made 63 hr.

Total time worked in week, 54 hr., for which regular wages of $16.20 were paid.

Efficiency = 63 × 100 ÷ 54 = 118 per cent.

Bonus earned = 29 per cent. of $16.20, or $4.69.

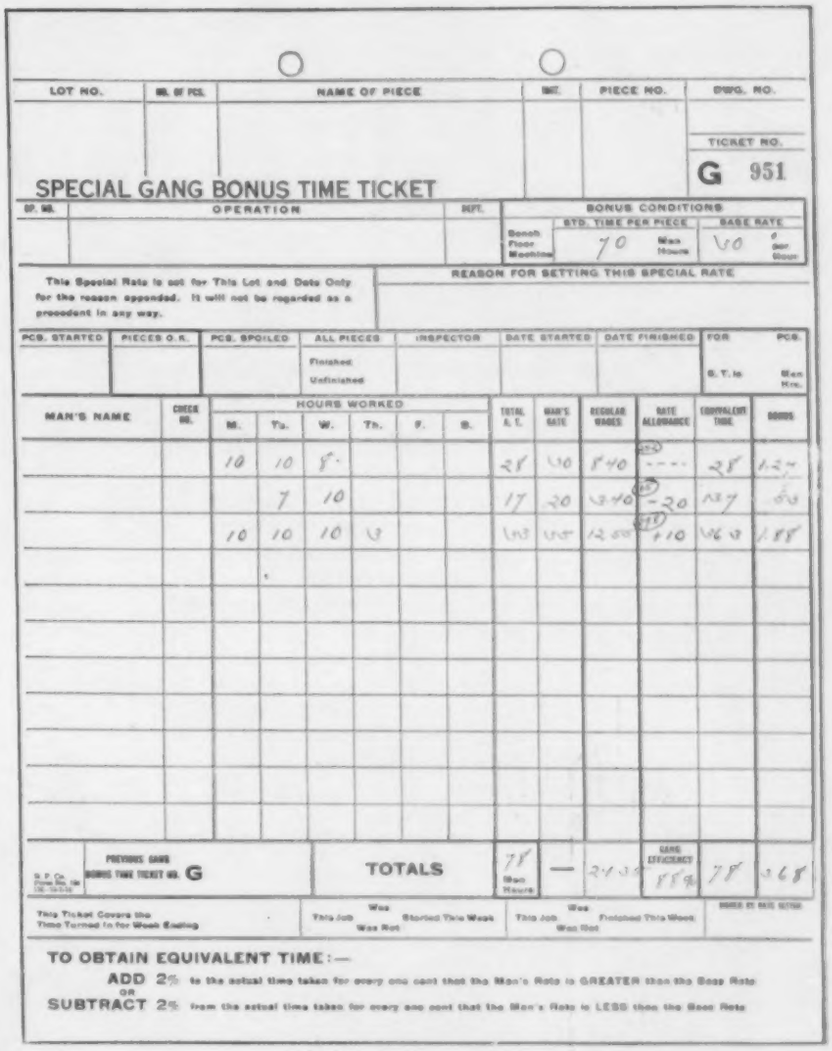
Men who usually work on long jobs have their bonus calculated every two weeks, instead of every week, in order to even up long jobs that run over from one week to another.

No bonus is paid on any castings rejected, for any cause. It is therefore to the interest of every molder to see that the cores given him are good, the pattern in good shape with all loose pieces fixed, the flask all right, etc. The only exception to this rule is, that castings rejected after leaving the foundry are not charged against the man who made them, unless the superintendent considers that the man was culpably negligent.

No bonus will be paid on any casting that weighs 10 per cent. more than its proper weight.

The standard time for molding includes an allowance for cutting sand, getting pattern and flask and all other necessary preparation, setting cores, closing up, pouring and shaking out.

The extra operation ticket, Fig. 3, makes corrections to preserve a man from loss of time for which he is not responsible.



LOT NO. | NO. OF PCS. | NAME OF PIECE | WT. | PIECE NO. | DWG. NO.

TICKET NO. G 951

SPECIAL GANG BONUS TIME TICKET

OP. NO. | OPERATION | DEPT. | BONUS CONDITIONS: STD. TIME PER PIECE (Bench / Floor / Machine) 70 Man Hours | BASE RATE 50 ¢ per Hour

This Special Rate is set for This Lot and Date Only for the reason appended. It will not be regarded as a precedent in any way.

REASON FOR SETTING THIS SPECIAL RATE

PCS. STARTED	PIECES O.K.	PCS. SPOILED	ALL PIECES: Finished / Unfinished	INSPECTOR	DATE STARTED	DATE FINISHED	FOR PCS. G. T. lo Man Hrs.

MAN'S NAME	CHECK NO.	HOURS WORKED M.	Tu.	W.	Th.	F.	S.	TOTAL A. T.	MAN'S RATE	REGULAR WAGES	RATE ALLOWANCE	EQUIVALENT TIME	BONUS
		10	10	8				28	50	8 40	----	28	1.27
			7	10				17	20	3 40	-20	13 7	.63
		10	10	10	3			13	85	12 50	+10	16 3	1.88

PREVIOUS GANG BONUS TIME TICKET NO. G | TOTALS | 78 Man Hours | — | 24 3 | GANG EFFICIENCY 118% | 78 | 3 68

This Ticket Covers the Time Turned In for Week Ending

This Job Was / Was Not Started This Week

This Job Was / Was Not Finished This Week

TO OBTAIN EQUIVALENT TIME:—
ADD 2% to the actual time taken for every one cent that the Man's Rate is GREATER than the Base Rate
or
SUBTRACT 2% from the actual time taken for every one cent that the Man's Rate is LESS than the Base Rate

Fig. 5—Special Gang Bonus Ticket

THE GANG BONUS SYSTEM

The method of applying the base rate and calculating the efficiency on a gang job is different to that on a one-man job. On a one-man job the efficiency is found by adjusting the time allowed to conform with the base rate and the man's rate and by dividing by the actual time taken without any change. On a gang job the time allowed is not changed, but the actual time taken by each man is adjusted to conform with the base rate and his own rate, the new time so found being called the "equivalent time." The efficiency of the gang is the time allowed divided by the total equivalent time.

To take care of this reversal in procedure the application of the base rate is also reversed. That is to say, if the man's rate is less than the base rate, his equivalent time on the job is also less. And vice versa if his rate is greater than the base rate his equivalent time is also greater. Each man working in the gang obtains the same per cent. bonus, the actual amount being the correct per cent. of the regular wages he received on the job. The sum of the bonuses calculated individually for each man should correspond with the bonus calculated for the total regular wages on the whole job.

Referring to the gang ticket, Fig. 5, the first man's rate is the same as base rate, therefore his equivalent time is the same as his actual time, or..... 28 hr.

The second man's rate is 10 cents less than base rate. His rate allowance is therefore 20 per cent. less and his equivalent time is 17—0.20 × 17, or..... 13.7 hr.

The third man's rate is 5 cents greater than base rate. His rate allowance is therefore 10 per cent. more and his equivalent time is 33 + 0.10 × 33, or..... 36.3 hr.

Total equivalent time of gang..... 78 hr.

The standard time was 70 hr. and therefore the efficiency of the gang is 70 × 100 ÷ 78 = 90 per cent. The bonus of each man in the gang is thus 15 per cent. of the wages he received while working on the job. The first man gets 15 per cent. of $8.40, the second gets 15 per cent. of $3.40, etc.

A standard time rate is never changed, as stated, following the practice of all successful bonus and premium systems. There is no penalizing for damage to equipment resulting from the effort to increase production. The usual experience when workmen start in under bonus is that they are afraid to take the heavy cuts and feeds prescribed for them, and are still more fearful of pushing machines on their own initiative. A penalty for breakage would be most depressing.

Each operation on each part of any product has its standard time record card, shown in Fig. 1. The particular example used is a foundry standard time record card, and the figures given in the lower left hand section are used in determining the proper time for the task through the aid of a special foundry slide rule. At the top of the card is the description of the piece and the operation to be performed, together with the standard time. On the reverse side of the card is kept the record of actual performances under commercial conditions, which constitutes an invaluable running comparison.

A comprehensive system of charts is maintained for the quick ascertaining of proper times on work of a standard character. Each operation has its individual chart; from the plotted curve the time for each size of the part is ascertained immediately. The chart shown in Fig. 6 gives every detail descriptive of the work of roughing and finish planing of the top and bottom of a high-speed lathe head, together with the fitting of the caps, for each size from 12 in. to 28 in. inclusive. Where work is done on machines or groups of machines of different pulling power, each has its own chart. That given as an illustration applies to the individual planer P45, as stated on it.

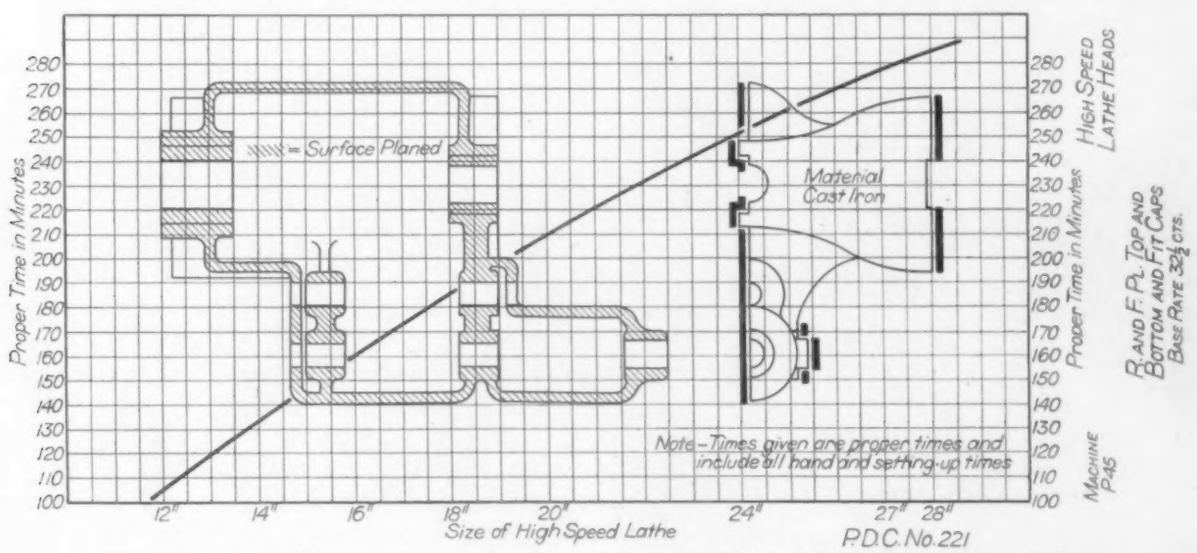


Fig. 6—Sample of the Charts from Which Standard Times Are Obtained Quickly for Any Size of Part

Machinery at the Panama Pacific International Exposition

The iron and steel industries will receive a wonderful impetus, particularly throughout the West as a result of the Panama Pacific International Exposition, according to A. A. Willoughby of the Exposition staff. The exhibits will far excel those of previous expositions, he says, in point of completeness and educational value. Practically every exhibitor is said to be making the largest exhibit he ever assembled for display purposes. The authorities have laid stress on the point that the exhibits must show something new in their makeup and something of the process of manufacture must be shown. Hence Machinery Palace will resemble a huge workshop.

The Crane Company of Chicago will occupy 4000 sq. ft. of space and display materials weighing approximately 300,000 lb. The largest single piece in the exhibit is a 72-in. hydraulically-operated gate-valve weighing 57,000 lb. and it is to be in continuous operation throughout the Exposition period. Various forms of steam traps will be in operation and the boiler used to generate the steam is heated electrically to avoid fire hazard in the building. Some 17,000 articles, some cut in sections, will be shown.

The Hydraulic Press Mfg. Company, Mount Gilead, Ohio, will exhibit, in charge of its Pacific Coast representatives, The Berger & Carter Company, San Francisco, a 150-ton hydraulic wheel press, a 75-ton hydraulic bar straightening press, a 30-ton hydraulic pipe bender, a 15-ton hydraulic broaching press and other hydraulic machinery, including pressure pumps, oil presses, scrap presses, etc.

The exhibit made by the Busch-Sulzer Bros.-Diesel Engine Company centers on a 500-hp. 4-cylinder Diesel engine which will burn California crude oil, having an asphaltum base. It is direct connected to an air compressor and will be in continuous operation 24 hr. a day driving a 375-kw. 250-volt Westinghouse direct-current generator tied into the Exposition power system in the building. The oil consumption of the engine and the current produced by the generator will be carefully measured so that visitors may see at a glance the quantity of oil being used and the power generated.

The Simonds Machinery Company, San Francisco, represents the American Steam Pump Company, the Luitwieler Pumping Engine Company and the Kewanee Pump Company, all of which are included in working exhibits.

The Worth Brothers Company, Coatesville, Pa., announces in an official circular, that it is prepared now to supply the trade with steel boiler tubes, having up to this time manufactured only charcoal tubes. This was foreshadowed when the company signed the specifications for boiler tubes in connection with the boiler code work of the American Society of Mechanical Engineers, as announced in *The Iron Age* at the time.

The Joseph Dick Foundry Company, Canton, Ohio, has been dissolved and the business taken over by the Joseph Dick Mfg. Company, the capital stock of which has been increased from $30,000 to $300,000. The latter company will hereafter conduct the business that has been carried on by the two separate companies.

The Whitman Agricultural Machinery Company, St. Louis, has completed a large number of hay presses for France, for use in connection with supplying the army with horse and cattle forage. The contract amounted to $100,000. Other orders of large size are reported in negotiation with the French and other governments.

Iron Ore Supplies for Seaboard Furnaces

Availability, Quality and Costs of the Product of European, Newfoundland, Cuban and South American Mines—Domestic Sources

BY EDWIN C. ECKEL*

In discussing the possible iron ore supplies for blast furnaces located along the Atlantic coast of the United States it would, of course, be possible to include a description of most of the ore deposits located on or near the Atlantic seaboard, whether in Europe or America. Such a catalogue of possible sources of ore supply would undoubtedly have its uses, but it is possible that another method of treating the subject may bring out more facts of real importance. Instead, therefore, of presenting detailed descriptions of ore deposits, it seems advisable to consider first the basis on which a seaboard steel plant is justified and the types of ore which its general requirements and limitations would enable it to use to the best advantage. After this is done, some comparative data on the more promising sources of supply will be directly serviceable.

THE BASIS AND REQUIREMENTS OF A SEABOARD PLANT

The matters which must be considered in this connection are those relating to the theory underlying the location of a steel plant on the Atlantic seaboard; the foreign competition it must meet, and the effects on such competition of the war and tariffs; also the processes and ores most likely to be adapted to the use of a plant so located. None can be discussed in detail, but all can be outlined.

The Theory of the Location. A plant located along the Atlantic coast would not necessarily depend for its profits on ability to manufacture pig iron more cheaply than furnaces at Pittsburgh or Birmingham; though it is conceivable that it would be able to do so under certain conditions. But the main basis for such a plant would be the facts that (1) a coast location gives cheap access to important domestic and export markets; (2) that certain locations along the coast afford excellent markets for by-products of all sorts; and (3) that at a few locations it is possible to combine a minimum assembling cost on materials with the best facilities for disposing of products.

With these basal conditions in mind, certain other facts become obvious. To secure the greatest advantages in marketing, the plant must be actually on tidewater and preferably near a large local market. To secure the greatest profit from by-products, it will presumably coke its coal in by-product plants at the furnaces. Further than this, it will use its slag to the greatest possible advantage in a good market. This implies cement manufacture for the furnace slag; and it might involve the deliberate manufacture of a high phosphorus slag in the steel plant. Phosphorus is an important commodity in the world's trade, and there is no cheaper way of making a fertilizer than in the basic open-hearth or basic converter. With the growing scarcity of high-grade natural phosphates this fact is becoming commercially obvious.

The War and the Tariff. The foreign competition which a seaboard plant would have to encounter will depend, in some degree, upon changes in our own tariffs and upon the results of the European war. So far as the last factor is concerned, we may assume that the relative competitive ability of our chief European competitors, among themselves, will not be seriously changed by the war. Westphalia, Lorraine and the Cleveland district will have the same coke and ore supplies, regardless of whose flag flies over the ships and the fortresses. And no victories on the Continent could make up for the fact that England's coking coal reserves are small in comparison to those of Germany. However the land may be divided after peace arrives, the iron-producing country along the Rhine and Moselle drainage will be our main European competitor.

On the other hand, there is one important point to be considered. There will be no serious change in competitive ability among themselves, but there will in any case be a falling off in the ability of these European countries to compete with the United States. No success in the war and no possible indemnity can ever make up for the fact that all of them are now mortgaging the labor and profits of the next generation at least, in order to supply funds for engaging in the present exhibition of the final results of commercial jealousy. For, after all, that is what this war amounts to. The pretexts alleged by both sides were trifling, but under them were trade antagonism and trade struggle. Whichever side wins, both contestants will have to

Sketch Map of North and South America Showing Important Ore Reserves in Relation to Atlantic Basin Traffic

*Consulting geologist, 1030 Munsey Building, Washington, D. C.

Entrance to a Slope at Wabana, Newfoundland. The Right Hand Side of the View Shows Very Clearly the Close Jointing Which is Characteristic of the Wabana Ore and is One Factor in Low Extraction Costs

face scarcity in both labor and capital. Wages in Europe after the war will probably rise to the American standard, which will lessen the possibility of serious European competition here. On the other hand, it will cut off or reduce heavily our own supply of imported labor; but allowing for this we will have a distinctly improved competitive position.

The matter of our own tariff may be dismissed with brief mention, for here we have to deal with political uncertainties, and not with facts. There seems to be real danger of over-estimating the results of the last election, and the probability of a return to high protective duties. So far as can be seen now, there is little chance of such a return. On the other hand, it is not likely that for some time to come there will be any chance to reduce the present duties. In dealing with future possibilities it will be safe to assume that the duties will be at least as high as those of the Underwood bill, and that they may be higher with regard to certain products, at least. Whenever Canada regains a sound financial position, we will see an agitation, particularly in the South, for a reasonable duty on pig iron and other crude products.

Typical Surface Exposure of Iron Ore, Northeast Texas. Illustrates the Character of the Surface in the Ore Region; Boulders of Ore Are Scattered Over the Ground

DOMESTIC SOURCES OF SUPPLY

The three possible domestic sources which might furnish any large ore tonnage to an Atlantic coast plant are the Adirondack and Highland region of New York, New Jersey and Pennsylvania; the northeast Texas region, and the Lake Superior district. There are, of course, a number of scattered mines which might perhaps ship to the coast, outside of the three districts named, but none of these scattered operations seems to promise any large tonnage for such use.

Adirondack and Highland Ores. The main domestic supply for the Atlantic coast region must come in future from the two areas of pre-Cambrian rocks which make up respectively the mass of the Adirondack region in northern New York, and the Highland region which reaches across from southern New York to southeastern Pennsylvania. Within these two areas there are large deposits of magnetic ores, commonly of low grade as mined, but susceptible of cheap and very clean concentration. It is these ores which are now the chief domestic resource in the area under consideration, and they must be considered important factors in any future developments there.

The magnetic ores of the Middle States differ widely in natural grade, in phosphorus content, in mining conditions and in transportation facilities to the coast; so that it is difficult to make any statement applying to the group as a whole. Perhaps it would be fair to say that the reserve tonnages may amount to 500,000,000 tons or more; that the shipping grade may vary from 50 per cent. iron up to 64 or 65 per cent.; that the phosphorus may range from the strict low phosphorus of Lyon Mountain up to several per cent. Omitting from consideration the deposits which cannot ship to the coast on a competitive basis, and also omitting the more uncommon types of ore, we might perhaps say that the average ore reaching the coast in future will range slightly above 60 per cent. iron,

Open Cut in Dominion or Big Seam at Wabana, Newfoundland. The Face in this Cut Shows Some 13 ft. of Clean Ore. The Thickness of the Bed, the Small Stripping and the Smooth Floor Are Well Brought Out in the View and All Are Important Factors in Securing Very Low Mining Costs Per Ton of Ore Shipped

with low phosphorus; and that it may cost somewhat under six cents per unit of iron. These ores, of course, will be concentrates and some of them will be very finely ground.

Texas as a Source of Supply. There is a very large amount of brown ore, the total having been estimated as high as 1,000,000,000 tons, scattered over a very large area in northeastern Texas. The thinness of the deposits and the transportation difficulties have prevented serious development hitherto, but it is possible that moderately large tonnages from this source may in time reach Atlantic coast ore markets.

If such shipments were on any large scale, the average grade would probably be a trifle under 50 per cent. metallic iron, though since the ores are hydrated this would not imply so high silica as a hard ore of equal iron percentage. Some of the tonnage would be lump, but the bulk would be finer material, either washed or screened. The phosphorus might range, as in many other Southern and Eastern brown ores, around 0.15 per cent. Delivered at Eastern coast, the total cost of handling and freight might be six cents per unit of iron.

Lake Superior Ores. During the past year or two public attention has been drawn, at intervals, to the improvements which are taking place in the New York canal system, and to the possible changes in traffic which may result from the completion of these improvements. Among these new traffic possibilities is, of course, the chance for placing Lake ores in New York harbor or other coast points at a considerably decreased freight cost.

From a purely economic standpoint there seems to be little excuse for placing much Lake ore tonnage on the Atlantic coast, even if freights are very materially reduced. There would always be more net profit per ton in selling Lake ore at the lower Lake ports than in putting it into competition with other ores along the Atlantic seaboard. Further than this, there is the question of reserve tonnage to be considered. The Lake Superior region has enormous total reserves; but these reserves are not large when compared with the increasing annual draft being made on them.

The steel companies would hardly consider selling any of their better grade Lake ores at New York; and it is questionable if many merchant ore miners would do it on any large scale. There is, however, one large producer whose position is so exceptional that it might justify heavy coast shipments as part of a general policy. The Great Northern properties have no fixed charges or heavy plant investment charged against them; the tonnage reserves are large as compared with the immediate market, and there is every reason to market a large tonnage annually. Under these circumstances marketing of some of the ore along the Atlantic coast would be justified by the same arguments applied to export trade in finished steel products. It would increase the total profits for the year, even though it might decrease the profits per ton.

FOREIGN SOURCES OF SUPPLY

Of the possible foreign sources of ore supply,

Test Pit in Surface Ore, Texas. The Thickness of the Ore Bed at This Point is Indicated by the Pick Handle as Being About 2 ft. This is Not Far From the Average Thickness Over the Entire Area

those located in Europe and north Africa may be passed over without discussion, for the need for these ores in English, Belgian and German furnaces exceeds our own. In consequence few of the Old World mines will find a profit in selling much of their tonnage on this side of the Atlantic in ordinary years.

The foreign ores which may furnish a heavy supply are located in Newfoundland, in Cuba and in South America; and concerning these the more important facts may be summarized to advantage.

Newfoundland. So far as Newfoundland is concerned, attention may be limited to the ore deposits of the Wabana or Bell Island basin, for rather careful geological work has made it probable that no other ore fields of this type exist elsewhere in Newfoundland. But this limitation does not minimize the importance of the colony as a future ore producer, for the Wabana field is probably one of the largest in the world.

We may safely assume that there are several thousand million tons of minable ore in the Wabana basin, including both surface and workable submarine ores. This is now mined at the rate, during ordinary years, of a little over 1,000,000 tons annually. It is probable that during a year of great demand the existing slopes and open cuts could furnish between 1,500,000 and 2,000,000 tons of ore without any material increase in equipment or cost. Should the demand ultimately reach a very large figure, promising to continue over a period of years, new slopes could be driven so as to yield an aggregate of 5,000,000 to 10,000,000 tons annually.

The ores occur in regular sedimentary beds ranging from 7 ft. to 30 ft. or more in thickness, so that development and operating expenses are low per ton of ore. It does not seem likely, even assuming the demand required mining at the rate of 5,000,000 tons or more per year, that the cost of the ore laid down at New York or Norfolk would be over five cents per unit. This is, of course, on the assumption of average freight rates and a reasonable amount of return tonnage such as coal or cement.

So far as reserve tonnage, possibility of heavy annual shipments and actual costs are concerned, Wabana is therefore the most important possibility along the Atlantic coast. The ore itself is dry lump, running from 50 to 53 per cent. metallic iron, and low sulphur. Its phosphorus content, however, is at a very difficult point, and this is the factor which has limited its use in the past. When used alone Wabana ore gives a pig metal ranging from 1.5 per cent. to 1.7 per cent. phosphorus. This is obviously too low for the basic Bessemer and a little too high for basic open hearth practice of ordinary type. In view of the enormous reserve tonnages available and the low cost per unit of iron, it seems probable that the final solution will be the adoption of a two-stage open hearth method, with the incidental production of a salable phosphatic slag. An ore field larger than the Lake Superior district will not remain unused simply because its phosphorus is at an inconvenient but not impossible ratio.

Canada. The ore producing possibilities of the Dominion of Canada, so far as they enter into the present question, may be dismissed with very brief mention. No iron ore deposits are at present known to exist in either New Brunswick or Nova Scotia which offer much hope of becoming important sources of supply for steel plants along the Atlantic coast of the United States. The ores which are known are of very moderate grade and still more moderate quantity; and they cannot be placed in New York on a competitive basis as against Newfoundland, Adirondack or Cuban ores.

Cuba. The iron ores of the Santiago region on the south coast of Cuba can hardly enter into the present discussion, since the tonnage remaining in these deposits is unlikely to reach a merchant ore market. With regard to the north coast ores, however, the case is very different, for the very large amounts available will in the course of time naturally be drawn upon more and more for the supply of Atlantic coast furnaces.

The conditions as to these north coast brown ores may be summarized as follows: They occur as surface blankets, and as the stripping is slight the actual mining costs are very low. The ores are, however, very high in both moisture and chemically combined water, the two running about 35 per cent. In order to remove this, the ores are nodulized or sintered. This is a fairly expensive operation; but it results in the formation of an ore carrying 50 to 55 per cent. metallic iron, and within the Bessemer limit in phosphorus.

The total ore reserves along the north coast of Cuba are estimated at several thousand million tons. This total is being drawn on at the rate of only about half a million tons a year. As to cost, delivered at north Atlantic ports, it may range between five and six cents per unit of iron.

South America. In the past there have been occasional shipments to the United States from Venezuela, and Chilean shipments are now in progress; so that South America may be considered a present contributor to our Atlantic coast tonnage. In spite of that fact, and of the admitted fact that the iron ore reserves of certain portions of South America are enormous, there is still much room for doubt as to how far that continent will become an important factor in the future. The reasons for uncertainty can best be developed if the different producing areas are taken up separately.

The Venezuelan iron mines served as the background for Davis's "Soldiers of Fortune"; and are attractive on that account. But they have also been the scene of a little play, which might be called "Capitalists in Misfortune," staged by Philadelphia and Montreal companies in turn; and this should serve as a warning against undue enthusiasm. The fact appears to be that, of the several different types of ore deposits which occur in Venezuela, active operations have been confined to contact deposits which change in grade and character very rapidly in depth. The companies attempting operation do not seem to have made any adequate geological exploration in advance of opening the mines, so that the results came as a surprise. Under present conditions there is no definite statement possible as to actual shipping grade or costs if large tonnages are to be handled.

With regard to the Chilean deposits the case is different, for here a great deal of work has been done, and more real information is available. We may assume that along the Chilean coast several hundred million tons of ore could be secured at reasonable mining cost, and within short haul of the coast. The grade would be high for a large part of this tonnage—over 65 per cent. iron and low phosphorus. As to costs delivered at Atlantic Coast points there is considerable uncertainty. Perhaps it might be safe to place them at eight to nine cents per unit of iron.

Brazil as a source of iron ore supply is also uncertain, but for other reasons. The reserve tonnages are very large, estimates placing the Brazilian field as the largest known ore territory in the world, with reserves of 7,000,000,000 tons or so. Whatever this may actually mean, it is certain that there is more ore there than will be needed in the next few

centuries. The question is how far this enormous tonnage is available for world use now, or in the near future. The difficulty here arises in connection with the question of transportation costs. The large ore deposits now under consideration are located from 300 to 400 miles back from the coast, and the ore will be shipped by rail to Rio or, more probably, to Victoria. Without considering construction cost for the railroad, it does not seem likely that a mountain road in a tropical country could afford freight rates under a half-cent per ton mile. To this must be added mining costs and port charges or export taxes, as well as water freight to the United States. Under present conditions, with no American bulk tonnage going to Brazil, ocean freights alone are very heavy. If we ever succeed in selling any heavy tonnage of coal or cement or other bulk commodity in South America, return rates on iron ore could be reduced correspondingly, but under existing conditions in normal years a rate of $3 per ton, Rio or Victoria to New York, must be taken as about the best obtainable. Counting in the mining, transportation to coast, port charges and ocean freights, it is questionable if Brazilian ores can reach our Atlantic coast ports at less than nine to ten cents per unit of iron. The ore is lump, with metallic iron over 65 per cent., and phosphorus very low.

The Machining of a Shrapnel Shell Case

The Reed-Prentice System, Using an Expanding Mandrel and a Floating Chuck, to Insure Concentricity of Inner and Outer Diameters

The manufacture of shrapnel shells has become a somewhat important factor in the metal and machinery industries with the progress of the European war. The Reed-Prentice Company, Worcester, Mass., has developed a practice by means of which a battery consisting of one turret lathe and two of the company's automatic lathes will produce shell cases at the rate of one in 6 to 7 min.

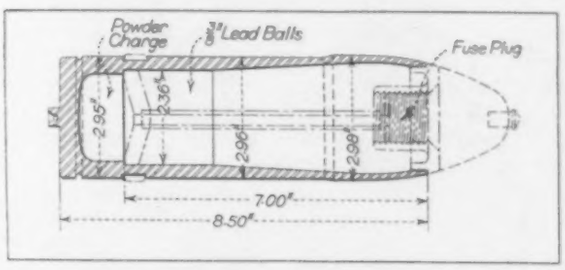


Fig. 1—The Shrapnel Shell Case

A shrapnel case consists commonly of a forging of alloy steel of high tensile strength, which necessitates relatively slow cutting speeds. The case, as shown in Fig. 1, has a space for the bursting charge at the closed end, which is covered by a diaphragm; a long section in which are contained something over 350 3/8-in. lead balls, and the fuse plug or nose, which carries a second diaphragm, which is the other retainer for the balls. The plug contains the fuse mechanism and a percussion cap, which explodes if the projectile strikes some object before the fuse acts upon the bursting charge. A tube containing quick-burning material connects the nose with the powder chamber.

The lathe fashions nothing but the case itself, the forging. As stated, this is of tough metal. It is not expected to burst. The English shell is designed to blow out at a point just outside of the threaded opening. Those of other foreign nations force out the thread. In either event the case acts as an aerial gun, hurling out a cone of bullets when the powder charge is ignited.

The specifications for large orders for shrapnel recently placed or about to be placed provide that a considerable part of the interior surface in the ball chamber be left in the rough. At the same time

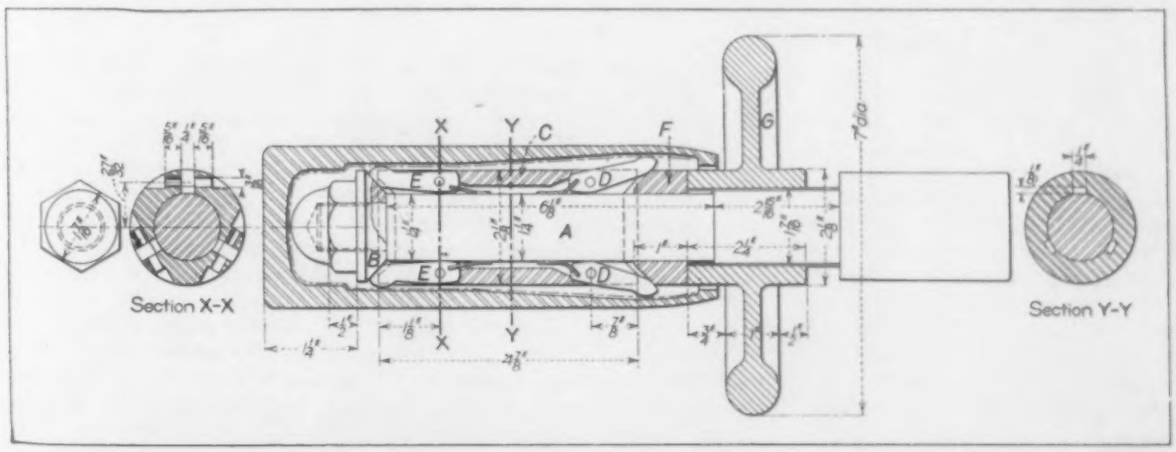


Fig. 2—Centering Device for Machinery

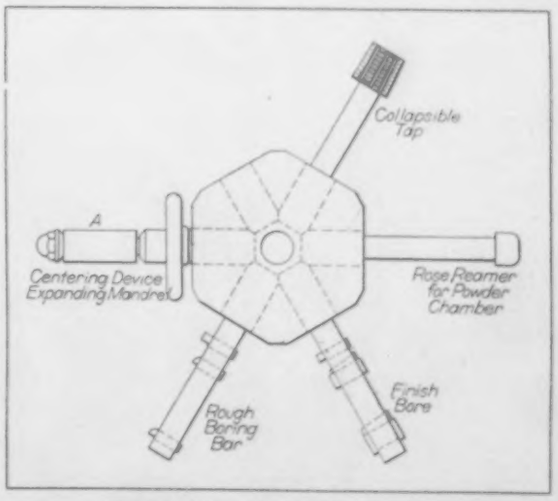


Fig. 3—Plan of Turret and Tools

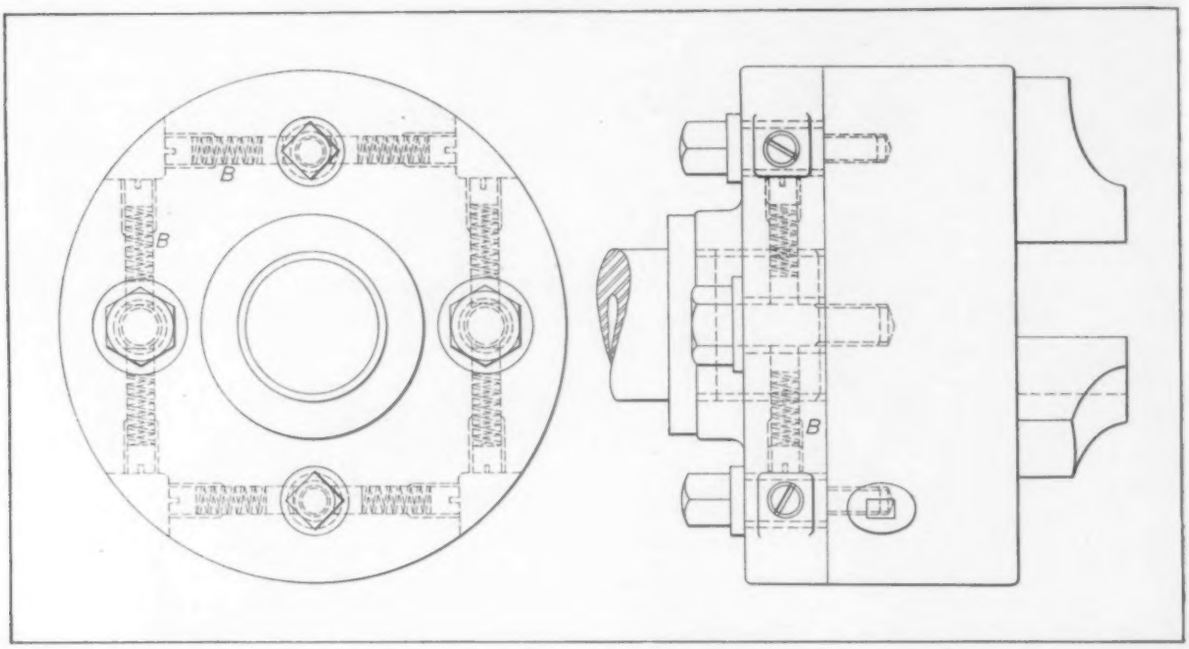


Fig. 4—The Reed-Prentice Floating Chuck

it is provided that the case be machined in such a way that the inner and outer diameters be concentric, for otherwise the projectile would not fly true. To accomplish this the Reed-Prentice Company has adopted the combination of an expanding mandrel and a floating chuck.

The first operation is to place the forging on the expanding mandrel, Fig. 2, which is fixed in one position of the turret, Fig. 3. The mandrel consists of the main arbor A, the further end of which acts as a depth gauge, it being important to maintain a uniform thickness of the closed ends of the shells; a fixed cone, B, at the outer end; a sliding sleeve, C, which carries the fingers D and E; a cone, F, and the handwheel G which is threaded to the main arbor. The fingers, when the arbor is in its inactive position, are held close to the arbor by means of flat springs, so that the work may be slid upon the mandrel. The action of the handwheel on the cone F is transmitted to the sliding sleeve, thus forcing the fingers against the walls of the shell case, their tension being equalized. The forgings often are eccentric. The mandrel introduces them to the floating chuck so that the interior is perfectly true.

When the work is mounted on the mandrel the turret is brought forward and introduces the shell into the chuck, Fig. 4. The floating element of the chuck is the Reed-Prentice Company's own design, the characteristic feature being the combination of springs which serve to hold the chuck in a central position when the binder screws are released. When the shell has been received in the jaws they are tightened and the chuck is locked to the plate.

The three tools of the roughing bar respectively seat the diaphragm, bore the threaded portion and face the open end. The finishing operations of boring are the same. The rose reamer finishes the powder chamber, and the collapsible tap threads the nose, ready to receive the fuse plug. While these operations are in progress the closed end of the shell is centered by a device which operates through the hole of the head spindle.

The outside of the shell is machined in the company's automatic lathes, one for roughing, the other for finishing. In order to support the work on centers a threaded driving plug is screwed into the open end of the shell. The machining is done by multiple tools mounted in front and rear blocks, as shown in Fig. 5. The front tools take care of the diameter work; the rear tools do the grooving, chamfering and facing down of the closed end. One front tool is mounted in a separate holder, controlled by the action of a cam surface which conforms to the profile of the curved end of the shell. The other three tools are held rigidly in one block secured to the carriage bottom slide which is operated automatically crossways of the carriage, thereby advancing all the tools to the given diameters.

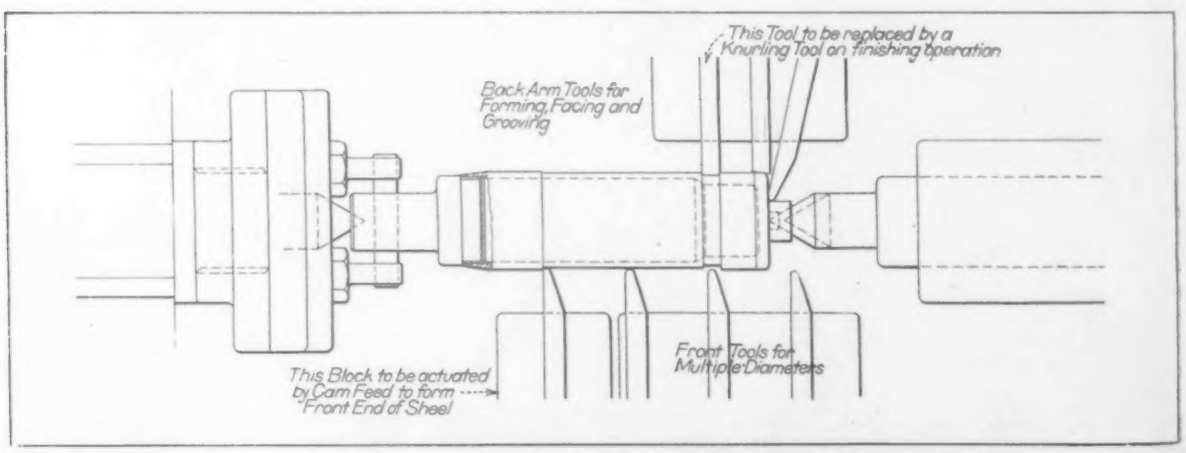

This Tool to be replaced by a Knurling Tool on finishing operation
Back Arm Tools for Forming, Facing and Grooving
Front Tools for Multiple Diameters
This Block to be actuated by Cam Feed to form Front End of Shell

Fig. 5—Layout of Tools for Turning Outside of Shells

Making Steel by the Duplex Process

Details of Temperatures and Chemistry—Three Methods of Recarbonizing—Duplexing a Commercial Success as to Cost and Quality

BY SIMON STROCK MARTIN*

After a number of years of experimenting, we find in the last year or so rapid strides toward duplexing, and when one considers the tonnages being made, the process seems to have an assurance of permanency.

THE TWO METHODS

There are two general methods used; one is through the Talbot and the other through an ordinary open-hearth furnace, preferably tilting. On account of the large reservoir of the Talbot furnace it probably has the lead and has at least made the most steel per year. The operating cost is less and the repairs fewer. When it comes to a period of depression and small output wanted, it would seem that a plant of smaller units is preferable. When we figure tons of steel per square foot of hearth area, it develops that results above those obtained with a Talbot or 200-ton furnace are easily produced.

It is my purpose only to describe here a plant of five 50-ton furnaces. Each furnace is capable of producing between 11 and 12 heats of 55 tons in 24 hr. throughout six days of the week and working on rail steel specifications entirely. The most important of the points common to both processes is that of not burdening the furnace with the converter slag. Lime addition is less and the volume of slag being less, the whole tends towards rapid work in the furnace. The various combinations of duplexing which have been used are:

1. Acid Bessemer and basic open hearth.
2. Basic Bessemer and basic open hearth.
3. Acid Bessemer and electric furnace.
4. Basic Bessemer and electric furnace.
5. Basic open hearth and electric furnace.

The choice of any of these depends largely upon local conditions. In some instances the chemistry of the iron is a large factor, while in others it is the demand for a large open-hearth output, or the scarcity of steel scrap and a surplus of molten pig iron. Should an effective method be developed of producing sound ingots so that discard may be reduced to 5 per cent., the supply of scrap will become a very important factor.

PRODUCTION AND QUALITY OF DUPLEX STEEL

The great growth in the use of the duplex process is indicated by the fact that in 1913 2,210,718 tons of duplex basic open-hearth ingots were produced, or 10.8 per cent. of the total basic open-hearth tonnage, this being a gain of 56 per cent. over the previous year. A still further increase can be looked for under improved conditions in the world's steel market. When we consider the use of the resultant slag from the basic open-hearth furnace, where conditions give sufficient phosphoric acid to warrant recovery, we readily see the value of keeping converter slag from the furnace. Slag from the converter has the following theoretical composition: SiO_2, 29 per cent.; FeO, 20 per cent.; MnO, 6.80 per cent.

As to quality of steel produced by the duplex process, as compared with the regular open-hearth process, no difference has been found and temperatures are really better controlled and more uniform in duplexing than in regular open-hearth practice. On account of the rapid tapping of heats, steel ladles are always hot and heats can be tapped with the metal at a lower temperature in the ingots. Ingots from duplex metal roll better than from regular open-hearth steel, as molds are kept at a more uniform temperature and hence less mold friction. The life of the molds naturally is greater, due to their being kept at this more uniform temperature. Again, with these lower temperatures of metal from the open-hearth furnace, the manganese additions are less—another direct saving as well as a much lower sulphur content of the steel when a fuel is used which tends to increase sulphur in the metal. This can readily be seen when one considers the time of the steel in the furnace. Regular open-hearth heats average from 8 to 10 hr., while duplex heats average 1 hr.

DETAILS OF THE DUPLEX PROCESS

Having treated the duplex process in a general way, we will consider the details of the process. For the successful operation of a duplex process, employing a converter for the preliminary refining of iron by eliminating the silicon and carbon, the following requirements must be met: First, an iron must be had of heat-producing elements sufficient to prevent any skulling of the blown metal in the duplex ladle; and for very rapid working in the open hearth the duplex metal must go into the open-hearth furnace at a temperature not much below the proper open-hearth tapping temperatures. Under such circumstances, the mechanical losses due to skulling in the ladles are entirely eliminated. Second, the location of the open-hearth furnaces, with reference to the Bessemer converter, must be such that the blown metal can be handled rapidly and independently of all other mill operation; thus the chance of any delays is reduced to a minimum. Failure to comply with these conditions has led to disappointing results in duplexing.

In view of the increased use of open-hearth rails, the provision of an open-hearth plant capable of keeping a modern rail mill engaged naturally looks like a large number of furnaces; but by duplexing this becomes a simple question, and if phosphorus is under 0.20 per cent. in the pig iron a plant of six furnaces should easily produce 2500 to 3000 tons of ingots in 24 hr.

The Bessemer Plant

The plan is to blow at one time sufficient metal for a 50-ton furnace and, therefore, we should have three 20-ton converters. With a sufficient supply of molten iron, the procedure would be to blow two heats at a time down to 0.10 or 0.15 per cent. carbon, and then, while pouring these two heats into the transfer ladle, blow the third heat. Fig. 1 shows a 60-ton transfer ladle. This ladle is designed for 75 tons. This large capacity counts on receiving all the converter slag so as to avoid unnecessary labor in gathering it up from the floor.

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The converter bottom has 24 tuyeres with eight 9/16-in. holes, giving a total effective area of 47 sq. in. per bottom. The life of the bottom varies with the quality of the iron, size of the heats and blast pressure, the required iron analysis for good practice being silicon, 1.00 to 1.25 per cent. This, on 20-ton heats, will give ample heat. Bottom tonnages should be from 700 to 900 tons. By assembling the complete open-hearth charge of blown metal in one ladle in the Bessemer, the time of transferring and charging an open-hearth furnace with duplex metal is brought down to 18 min. for about 56 to 60 tons. Fig. 1 shows the transfer ladle used to convey metal to the open hearth. The metal in the transfer ladle is gross weighed. After the metal is charged into the furnace the transfer ladle and slag are weighed, and thus the net weight of the total charge is obtained.

The Open-Hearth Plant

As to the open-hearth plant, we will take as our example one built in 1910, consisting of five furnaces.

For duplexing in an open-hearth furnace, the requisites are plenty of crane service on both charging and pit sides of the furnace. When four furnaces are duplexing, it is necessary to tap and teem between 40 and 45 heats of 55 tons each every 24 hr. For this reason there should be 14 transfer ladles and 14 steel ladles of 75 tons capacity each. The transfer ladle from the Bessemer is put in position, as shown in Fig. 2, and one of the three methods, described later, used for making the steel.

It will be noted there is no runner used in charging the metal into the furnace, each transfer ladle being fitted with an 18-in. spout to receive the metal from the nozzle. The ladle is placed within two feet of the furnace door, the nozzle having been filled with dry, burnt core sand and clay plug with a plate to keep it in. The helper, on a small platform on a level with the nozzle, takes a short bent bar, picks out the small clay plug, loosens the sand in the nozzle, and the stream of metal shoots out at a right angle to the ladle through the furnace door. The time for running a heat varies with the size of the nozzle, depending upon how many heats have been made through same. It is usual practice to make from six to eight heats off each nozzle. The total time from the pouring of the metal out of converter nose to transferring all to the open-hearth furnace is 25 to 30 min.

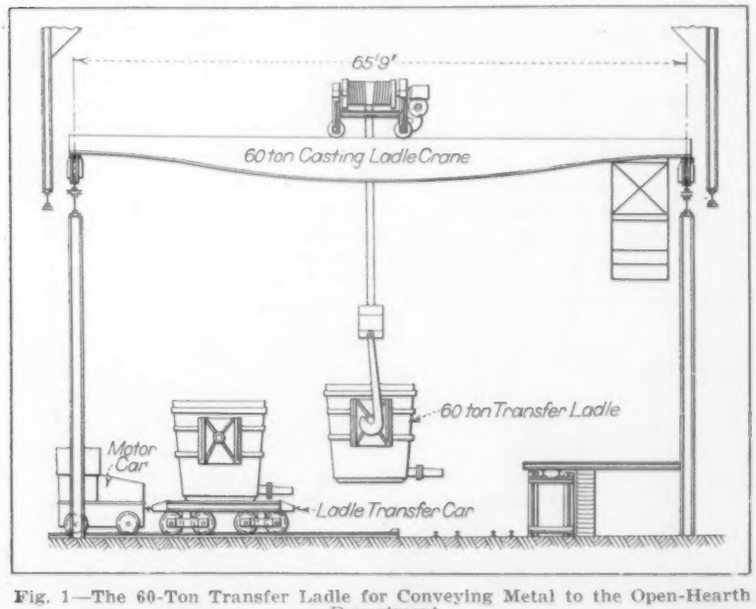


Fig. 1—The 60-Ton Transfer Ladle for Conveying Metal to the Open-Hearth Department

There are few cases in which trouble is encountered in opening the nozzle on the transfer ladle. These exceptions usually prove the value of the method as the heat takes three times as long on account of slag going into the furnace. If this nozzle does not open, of course the metal is poured over the top, slag being carried into the furnace. Before the transfer metal is charged, the furnace has already had its slag line made up with the following mixture: 1 to 2 per cent. of burnt lime, and 1¼ per cent. mill scale.

If the furnace must necessarily stand some time, steel scrap is charged and the melting of this scrap proceeded with, awaiting the transfer metal. The lime and scale, however, must have sufficient time to become thoroughly "cut up" before the duplex metal goes into the furnace. The time elapsing between the charges varies from 20 to 60 min., 40 min. being the maximum allowed, and any time over this is charged as a delay or waiting for "transfer metal."

THREE METHODS OF RECARBONIZING

A discussion of this method of blowing in the Bessemer naturally results since the general practice is to catch heats in the Bessemer so as to get 0.80 per cent. carbon as an average of the heats necessary to make up an open-hearth charge. From experience and knowing that many heats are not of the desired carbon content, the method of blowing comparatively clean of carbon has developed so that all metal going into the open-hearth furnace is of known composition.

The difference in methods which must be considered are:

First, recarbonizing the blown metal in the transfer ladle to 0.80 per cent. carbon and catching the heat within specifications.

Second, recarbonizing the blown metal after it is charged into the open-hearth furnace to 0.80 per cent. carbon and then catching heats within carbon specifications.

Third, recarbonizing the blown metal after it is charged into the open-hearth furnace to 0.20 carbon and then recarbonize in the steel ladle.

The First Method

The duplex metal, now in the furnace according to first method, analyzes:

Carbon	0.70	to 0.80	per cent.
Manganese	0.10	to 0.15	per cent.
Phosphorus	0.015	to 0.008	per cent.
Sulphur	0.04		per cent.

The phosphorus has been eliminated on the small reaction as the metal goes into the furnace. The time elapsing between the taking of the sample and results from the laboratory is 25 to 30 min. All carbons should be determined by direct combustion. The heat, in the meantime, is taking on action, and, if necessary, a few shovels of fluorspar are added. By the time the results are received from the laboratory, the heat is ready to tap, if the temperature of the bath is sufficient. To go out on the first test, the melter has the tap hole open and the ladle hung, and if the analysis is within the limits the heat is tapped. In case the bath is not the proper temperature or carbon too high, another test has already been worked, as the melter should take test every 20 min. On receipt of the second result, within limits, the heat is tapped. The manganese addition can either be

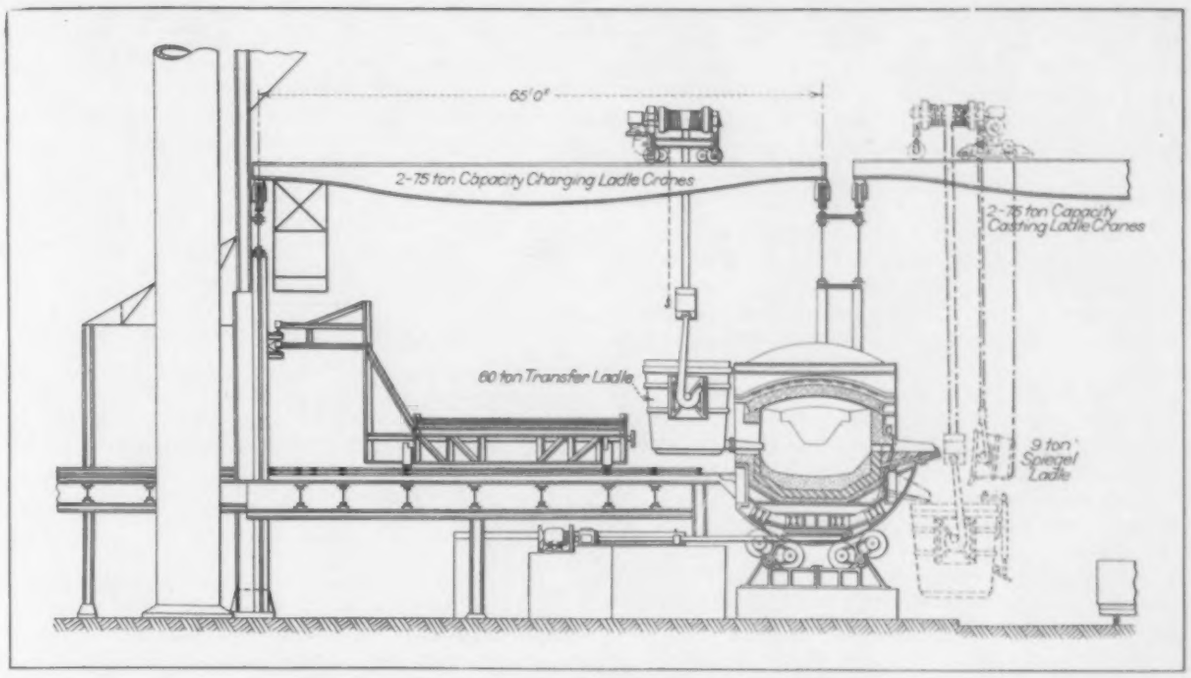

65'0"
2-75 ton Capacity Charging Ladle Cranes
2-75 ton Capacity Casting Ladle Cranes
60 ton Transfer Ladle
9 ton Spiegel Ladle

Fig. 2—Recarbonizing the Metal in Open-Hearth Furnace

made with 20 per cent. spiegeleisen charged into the furnace, or 80 per cent. ferromanganese into the steel ladle. Silicon additions are made in the steel ladle if 50 per cent. ferrosilicon is used. If 11 per cent. is used, it is added in the furnace. A good average time of heats in the furnace is 45 min.

The first method has the advantage of rapidity and ease of operation, there being no further metal additions nor boil in the furnace, which causes heavy repairs to the furnace linings. This undoubtedly is the quickest known duplex method at this time. Loss in duplexing by the first method is estimated as follows:

Chemical loss in converting	7.00 per cent.
Mechanical loss in converting	0.75 per cent.
Chemical loss in the open hearth	0.50 per cent.
Mechanical loss in the open hearth	3.00 per cent.
Total	11.25 per cent.

A typical analysis of open-hearth slag, produced by the first method, is:

SiO_2	8 per cent.
FeO	20 per cent.
MnO	6 per cent.
CaO	40 per cent.

The Second Method

With this method, the iron is blown as previously described, and the duplex metal has the following composition:

Carbon	0.10 to 0.15 per cent.
Manganese	0.10 per cent.

This metal is taken to the open-hearth as formerly described, the furnace, which has been prepared for the charge, having its slag line made up as follows: 2 to 3 per cent. of burnt lime and 1 to 1¼ per cent. mill scale.

As the addition of 20 per cent. of hot metal in the furnace raises the SiO_2 in the slag, the percentage of lime is necessarily higher. This hot metal is added to the furnace as soon as the duplex metal is in and causes the previous dead soft metal in the furnace to take on a violent action. In this connection, it might be of interest to know that it has been found necessary to run the dead soft metal much hotter so as to get it through the transfer ladle without skulling. The metal for the first method, on account of the carbon content, will hold the temperature better without a tendency to skull. As soon as the iron is through the bath, a test is taken and the same procedure as in the first method is followed to complete heat.

The Third Method

In this method the iron is blown as previously described and is of the same composition. This 0.10 carbon metal is charged into the furnace the same as in the second method and enough molten iron added to bring the carbon to 0.20 per cent. If the heat is hot enough and of the proper analysis, the right amount of molten spiegeleisen is tapped from the cupola into a 10-ton ladle and enough molten iron added to give the correct manganese-carbon addition to the open-hearth heat. This small ladle, containing the recarbonizer, is picked up by the auxiliary on the casting crane and carried to the furnace to be tapped, and the heat is recarbonized as shown in Fig. 2. The metal in the furnace must be at a higher temperature than in the first method on account of the cooling effect of the addition of the recarbonizer in the casting ladle. This requires the furnace to be carried at a higher temperature with a corresponding shortening of its life. Another question arises here as to whether the steel is of as uniform a carbon content as if caught in the furnace.

A good average time for such heats through the furnace is 1 hr. 30 min. On account of the recarbonizer addition in the ladle the heats will weigh 60 tons instead of 50 tons, this extra metal not going through the furnace. However, we must not lose sight of the greater wear on the furnaces, ladles, etc., on account of the violent reactions both in the furnace and steel ladle.

The average open-hearth analysis of slag in furnace on the second and third methods is:

SiO_2	12 per cent.
FeO	22 per cent.
MnO	6 per cent.
CaO	40 per cent.

THE QUESTION OF FUELS

Producer gas has been used, but from an operating standpoint on rail steel specifications, oil is preferable. In dull periods where the plant only operates part of the time per week, with gas producers, all must be kept banked for a shut-down

period, and when starting gas needs more time to get warmed up and to get a temperature high enough to be effective, while with oil, in starting furnaces, it can be done in at least 60 per cent. of the time required with gas. A comparison of coal and oil as fuels is as follows:

Coal per ton steel	210 pounds
Oil per ton steel	12 gallons

Twelve gallons of oil equals 1,782,960 B.t.u., or 149 lb. coal per ton steel. This includes all oil necessary to heat up a furnace at week ends as well as keeping a furnace hot during periods of waiting for transfer metal. In fact, with the usual weekly operation on a limited tonnage, with full operation 7 days per week, probably 7 gal. per ton of steel would be ample. On account of sulphur in fuel oil, it was thought that the metal would absorb too much sulphur; however, in practice, and on account of reversing the method of introducing gas through the bottom port and air through the top port of an open-hearth furnace, the operation consists in introducing air in the bottom port and oil over the air. In this way the sulphur is controlled and eliminated so that it is found that, in duplexing, no sulphur is absorbed by the metal, while on an iron-and-steel-scrap charge in trial heats, on which the total sulphur content of the charge was known, the sulphur did not increase over 0.01 per cent.

OUTPUT PER SQUARE FOOT OF HEARTH AREA

In comparing hearth areas, we find the following table interesting:

Type of furnace	Rated	Tons of ingots per sq. ft. hearth area
Talbot	200 tons	0.07
Tilting	50 tons	0.115

The following table gives some idea of how misleading the nominal rated capacity of a furnace is and how necessary the actual hearth area is to obtain a true conception as to the working of different furnaces we wish to compare:

Dimensions of Some Furnaces of Different Plants

Name	Rated capacity, tons		Actual bath area	Sq. ft. of bath per ton	Avg. depth of metal	Type of furnace
"A"	200		591, 375	2.95	24"	Talbot
"B"	50		175	3.50	18"	Campbell
"C"	...		...	....	...	Talbot
"D"	...		...	....	...	Campbell
"E"	...		...	....	...	Talbot
"F"	...		...	....	...	Stationary
"G"	100		493	4.93	...	Stationary
"H"	80 85 100	Avg.	492	5.78	..	Stationary
"I"	50		420	8.40	...	Stationary
"J"	50		450	9.0	...	Stationary
"K"	50		448	9.0	...	Stationary
"L"	60		472	7.9	...	Stationary
"M"	60		488	8.1	...	Stationary
"N"	60		576	9.6	...	Stationary
"O"	75		720	9.6	...	Stationary
"P"	75		640	8.5	...	Stationary
"Q"	40		328	8.2	...	Stationary

In making comparisons between losses in the duplex process and cold charge process the fact must be remembered that the main difference in the loss in the duplex process is due to the elimination of carbon, silicon, etc., in the converter, whereas the scrap used in the ordinary open-hearth process has already withstood such a loss in its original conversion.

CONCLUSIONS

In conclusion, we must admit that notwithstanding the prejudice against duplexing on account of the cost due to loss, this has been practically eliminated by improved methods of manufacture, and it is now possible to get such a "cost above" as is perfectly satisfactory to the manufacturer. When we consider the very uniform temperatures and steel analysis as well as tons produced per dollars invested; the melting of a large percentage of steel scrap in the Bessemer converters, if desired (as much as 25 per cent. if the silicon content of the iron will permit); and the separating of the blown metal from the silicious Bessemer slag—duplexing is a commercial success and has come to stay.

With regard to quality of steel, a record of the actual failures in service as related to the total rails produced from each kind of steel shows a smaller percentage of failures from duplex metal than from cold charge heats.

How the Government Underpays Railroads

Since the outbreak of war in Europe the United States Government has shipped nearly 200 tons of gold, worth about $99,000,000, from Philadelphia to New York without cost for railroad transportation. This was accomplished by sending the gold by parcel post. Railroad mail pay provides compensation only for carrying the ordinary mail and includes no specific allowance for such extraordinary service as handling gold transfers for the Treasury Department. The postal officials, nevertheless, took the ground that the gold must be carried, without additional payment, under the four-year contract for transporting the regular mails.

The largest single transfer of the gold consisted of $50,000,000 in double eagles from the Philadelphia mint. It was divided into three installments, sent on as many successive days. To convey these 100 tons of treasure 91 miles to New York, the railroad furnished, altogether, four special cars. As an extra precaution, requested by the postal authorities, the cars were detached from the regular trains some miles from destination and hauled the remainder of the way by special locomotives. Round trip transportation was provided for more than 100 postal clerks and inspectors who accompanied the gold as guards and for each of whom the railroad company was obliged to assume the same liability as for a passenger paying full fare. All of this was done without any compensation to the railroad beyond the regular monthly payment for the routine mail service.

Progress Made in 30 Years by a Crane Builder

The month of December, 1914, marked the thirtieth anniversary of the Pawling & Harnischfeger Company, builder of cranes, Milwaukee, Wis. In commemoration of this event, the company has issued a 50-page brochure relating to the changes that have taken place in the business since its foundation. Brief sketches of the men prominent in the company's affairs are presented, together with illustrations of some of the products of the plant. Although cranes and hoists are the chief line manufactured, grab buckets for foundry service, monorail systems, horizontal boring and drilling machines, wheel and boom type excavators and power traction tampers are also made.

The annual salesmen's banquet of the Domhoff & Joyce Company, Cincinnati, Ohio, was held at the Hotel Havlin in that city on the evening of December 30. President John Sargeant was presented with a handsome traveling bag. The following officers and salesmen were present: John Sargeant, president; C. A. Sargeant, secretary; C. H. Jenkins and R. D. Jenkins, Chicago; W. G. Maguire, St. Louis; A. H. Vollmer, Cleveland; W. T. Norris and J. C. Gore, Indianapolis; P. M. McClanahan, Charleston, W. Va.; D. H. Morton, Milburn, W. Va., and T. J. Joyce, J. D. Morten, W. H. Underwood, H. H. Sargeant, S. T. Story, G. K. Connelly, A. C. Cole, C. Hayward, Willis Cobb, S. Borreson, E. Seale and A. Hawthorne, Cincinnati.

The West Virginia Board of Trade has under consideration bills which will be presented to the Legislature of that state, providing for the settlement of labor troubles by a plan closely following that of the Canadian industrial disputes act.

Panama Pacific International Exposition

The Large-Scale Time-Limited Construction Problems—Foundations in Sand, Fire Protection, Water Supply, Light and Power

(With Supplemental Plate)

BY E. P. LESLEY*

The Panama Pacific International Exposition will open in San Francisco on February 20, 1915. The purpose of this exposition is to commemorate fittingly the completion of the Panama Canal, the world's greatest engineering undertaking.

The building of the exposition too has been an engineering achievement. At the outset there was perhaps some politics, much business and little engineering. More than one city desired the exposition. When San Francisco was finally chosen, there remained the selection and acquisition of a site. This involved many business transactions and took time and money. But there were engineering questions to be considered as well as business to be done, if the best site were secured. Vast quantities of building material were to be transported to the site and handled there, great structures were to be erected. When finally completed the exposition must be easily accessible from San Francisco and the cities across the bay.

THE PROBLEMS OF THE SITE

An ideal site of 625 acres, comprising parts of the Fort Mason and Presidio military reservations and 76 city blocks lying between them was obtained. This area extends 2 1/3 miles in an east and west direction along the south shore of San Francisco bay. It has 2 miles of excellent water front. Ocean-going steamers as well as bay and river craft may discharge freight and passengers directly on the Exposition grounds. At the eastern end is Van Ness Avenue, one of the city's largest thoroughfares, and along the south side is a widened city street. The well equipped and efficient San Francisco municipal railroad furnishes a direct route from the ferry depot and the downtown hotel district to the Exposition. To the southwest are the green tree-covered hills of the Presidio Reservation. The view from the exposition water front is unsurpassed. Out of the blue water of San Francisco bay rise Angel and Alcatraz islands. In the distance are the Marin County hills with Mt. Tamalpias in the background.

Securing the site involved execution of leases and deeds with 175 different parties. Rights were acquired in nearly 200 separate parcels of land. Where it was impossible to lease on reasonable terms the Exposition Company bought outright. The complete plant of an engineering and shipbuilding company was purchased as well as smaller holdings of other parties, so that the Exposition Company now owns in fee simple 12.26 acres. Many of the city lots leased were occupied by improvements. A few of the dwellings were removed by their owners to other locations, but about 400 dwellings, barns and other structures were purchased, wrecked and removed by the Exposition Company. Before the removal of any improvements a very careful survey was made. The whole tract was laid out in 50 ft. coordinates. Every curb, sidewalk, telephone pole, street light, fire hydrant, house, tree or other improvement was accurately located. The purpose of this survey and layout by coordinates was twofold: to simplify planning and placing of exposition structures and to facilitate such restoration of the site to its original condition as is required at the close of the Exposition.

Part of the site was composed of "water lots," an inland water filled basin cut off from San Francisco bay by a riprap sea wall. The appearance, in August, 1912, of a portion of the grounds where the Palace of Machinery and other large buildings now stand is shown in an accompanying illustration. The water lots were filled by hydraulic dredging with about 70 per cent. sand and 30 per cent. silt. Great care was taken that the fill should be of such character that it would settle as little and yet as quickly as possible so that building construction could begin at an early date. The pipe discharge was examined at frequent intervals and if found undesirable the dredger was moved until satisfactory discharge was obtained. Some 1,700,000 cu. yd. of fill were placed at a cost of $301,000.

Filling and clearing completed, active building construction was immediately started. The department of architecture of the Division of Works had prepared a block plan and the designs for the architectural and esthetic features of the main exhibit palaces. The department of construction and specially commissioned structural engineers had prepared plans for the structural features of the buildings. To facilitate preparation of structural plans, an architectural engineer was detailed to work with the architects and obtain complete information as to the location of posts, wall lines, openings, etc., or any data that might be necessary or useful in preparing plans and specifications for the structural frames and foundations. This method greatly facilitated rapid execution of contract drawings. The annoying delays often prevalent in developing engineering plans in connection with architectural work were eliminated.

As large buildings were to be located on recently filled ground, experiments were conducted to determine its supporting power. At the usual depth for spread footing foundations, it was found that the supporting power of the dredger sand was very low, viz., about 400 lb. per square foot. This prohibited the use of spread footings in the filled areas. Pile tests were also made and it was found that the fill in settling gripped the piles in such a manner as to act as a load on them. This caused them to penetrate to the original bottom. Careful consideration led to the conclusion that it would be unwise to use piling foundations to support a given load by skin friction alone, since with the load they would settle with and more rapidly than the fill itself. Test borings showed that the soil under the fill was of clay mixed with blue mud and water, underlaid with hard green sand and clay and finally hardpan, the latter being from 30 to 120 ft. below the surface. A great number of piles were required and economy was a considerable factor. Is was therefore decided to drive all piles to the layer of green sand and clay overlying the hardpan, to a 1-in. penetration at the last blow.

The soil underlying building sites not covered

*Department of Mechanical Engineering, Leland Stanford Junior University.

by dredger fill was found to be yellow beach sand, hard green sand and clay and yellow hardpan. It was decided to use piles to support all buildings and special loads in this area as well as in that covered by the recent fill. There were three reasons for this decision: first, uniformity of construction; second, greater safety in case of earthquake; and third, cost. The San Francisco experience had shown that greatest damage was done to buildings on spread or raft footings. Allowing 3000 lb. per square foot for sand, it was found that spread footings would be as expensive or more so than piles.

GENERAL PREPARATION FOR THE BUILDINGS

With the exception of the Palace of Fine Arts, the Tower of Jewels and the dome of the Palace of Horticulture, the exposition buildings are of wood construction overlaid with staff and plaster in imitation of Roman travertine marble. The department of construction prepared all foundation plans, floor framing plans, roof framing plans and sufficient sections and elevations to show all framing. These with specifications were furnished to contractors for tenders. Contractors were required to furnish plans of construction details for approval but were given sufficient information to prepare them without computation for sizes of members and connections. A bureau of estimates prepared working estimates from the plans and specifications furnished for tenders. In this way possible pooling of bids by contractors was eliminated and it was assured that contracts were let at figures that would enable the contractor to make a reasonable profit if the work were well handled. Practically all construction of railroads, roads, sewers, water distributing systems, as well as of buildings was done by contract.

All timber and lumber for building construction was supplied by the Exposition Company. On the main exhibit palaces 70,000,000 ft. board measure were used. It was purchased directly from mills in Washington and Oregon and delivered on the dock at the exposition grounds by steam schooners carrying from 150,000 to 800,000 ft. The timber is mainly Douglas fir; sizes varying from 1 x 4 in. x 6 ft. to 12 x 12 in. and 16 x 16 in. x 70 ft. Not only was a very considerable sum saved by buying in this way but also wisdom in the choice of site was demonstrated. Delivery was quick, in lots convenient to handle and material was placed at building locations more economically than would have been possible with any other available site or if purchase had been made by contractors through local dealers.

The activity of the various departments and bureaus of the Division of Works has not been confined to the main exhibit palaces and grounds. All designs, plans and specifications for state and foreign pavilions and for concessions were thoroughly examined and approved before construction was permitted. While considerable latitude has been allowed in architectural and decorative features, care has been taken that adjacent buildings should in some measure complement each other. All contracts were critically investigated to assure that the interests of both parties were properly guarded.

The structural engineering excellence of the exhibit palaces is hidden to the untrained observer under the more apparent but none the less excellent architectural, esthetic and decorative features. Indeed a very great part of all the engineering work in the design and construction of the Exposition is now concealed. All buildings have first class fire protection and domestic water supply. There is a complete system for disposal of sanitary sewage and storm water. Electric power and light is distributed through underground conduits. Steam and high-pressure gas are available where required.

FIRE PROTECTION SERVICE

For primary fire protection, pipe sizes were determined that would allow a delivery of 15,000 gal. per minute over areas of 100,000 sq. ft. under a running pressure of 200 lb. per square inch. This pressure is maintained at the most remote point of the main group of buildings. The piping is 6, 8, 10, 12, and 16 in. lap welded steel, asphalt dipped; with Dresser steel sleeve connections, extra heavy cast-iron fittings and sufficient gate valves properly to sectionalize the system. All of the pipe and fittings were given a shop test of 500 lb. per square inch hydrostatic pressure and a field test of 450 lb. per square inch. The system is connected to the auxiliary water supply of the city and county of San Francisco, drawing on the Twin Peaks reservoir at an elevation of 756 ft. through the Ashbury Heights tank at 462 ft.

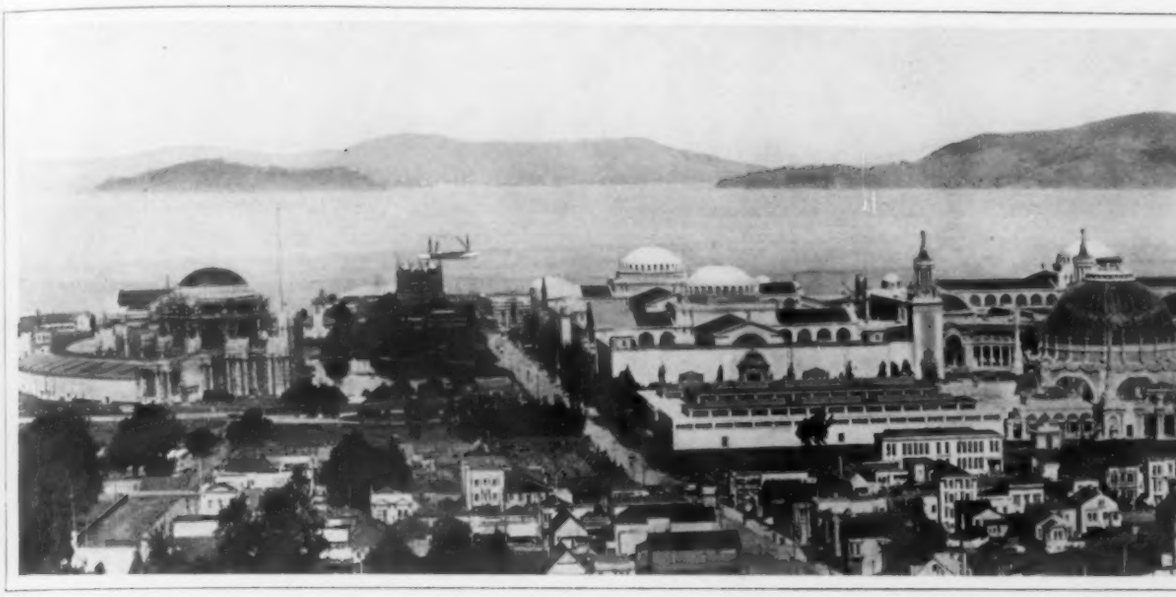
In addition two fire-boat connections are provided on the Exposition water front, so that the municipal fire boats may, when necessary, pump salt water into the Exposition system. The capacity of the fire boats is 10,000 gal. per minute at 150 lb. pressure and 4500 gal. per minute at 200 lb. pressure. Under ordinary conditions the system will contain fresh water. There are no visible unsightly fire hydrants along the driveways and walks of the Exposition grounds. They are of the concealed or flush type, set directly over the mains and spaced about 300 ft. apart. Each hydrant has two 3-in. outlets with standard San Francisco fire department hose connections. Connections to the main buildings are 8 in. extra-heavy screwed pipe. Four connections are provided to each building, one on each side.

The buildings of the main group are supplied with automatic sprinklers and with a hand-controlled system of cornice sprinklers. Roofs are of felt, covered with asbestos and painted with fire retarding paint. The Palace of Fine Arts is a steel frame fireproof structure.

THE DOMESTIC WATER SUPPLY SERVICE

The domestic water supply serves also for secondary fire protection. A system of 4, 6, 8, 10 and 12-in. pipe is laid parallel in general with the high-pressure system. This installation contemplates a possible demand of 3,500,000 gal. per day with a maximum rate of one and one-half times that amount. Concealed or flush type hydrants, spaced about 400 ft. apart, are set directly over the mains. These hydrants have single 3-in. outlets to which the motor-driven pumping engines of the Exposition fire department may be attached. Within the buildings cross connections to the high-pressure system are provided so that both primary and secondary supply are available for automatic and hand controlled sprinklers. A pressure of 50 lb. per square inch at the curb in front of all buildings is maintained in the domestic water system.

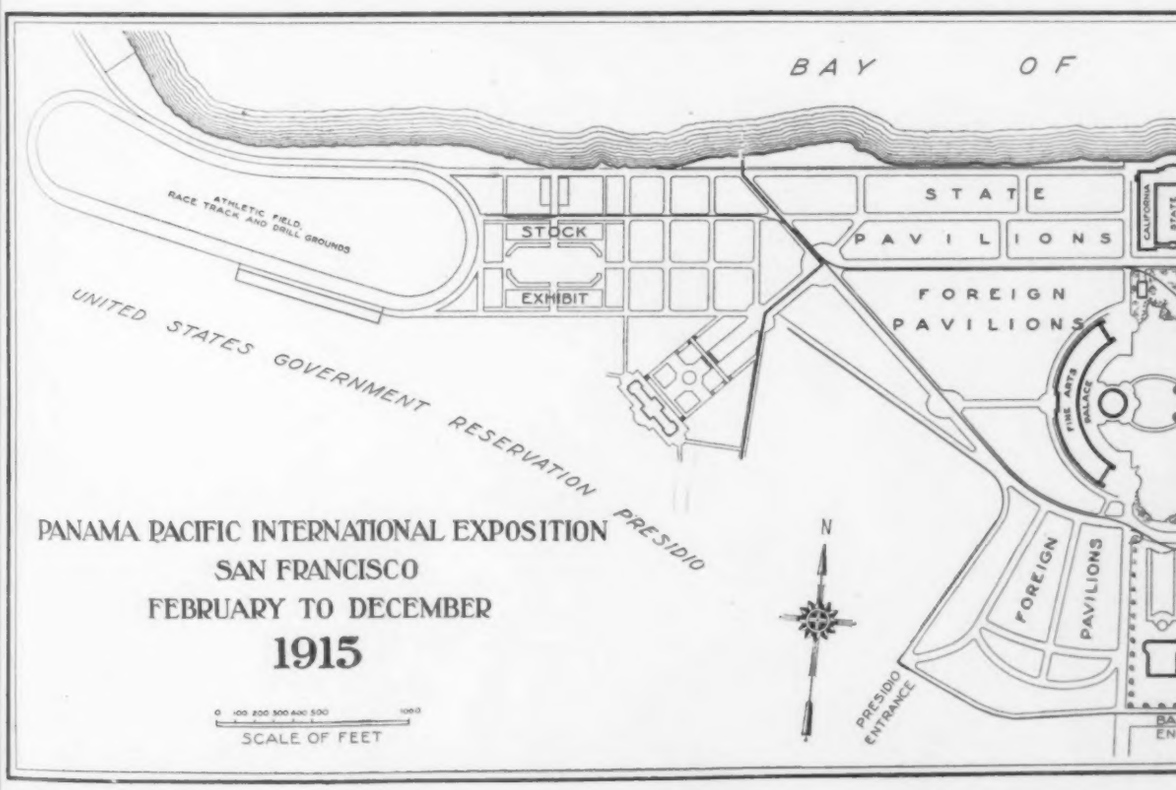
The buildings of the main group are not widely separated. They are connected by continuous facades or colonnades, enclosing courts with fountains, lagoons and gardens. The connecting links however are provided with re-inforced concrete fire walls to prevent spread of fire from one building to another. The extreme precaution of cornice sprinklers, asbestos roofs and the like, for buildings that are to be torn down in another year has been taken in order that the fire risk shall be as little as possible.



A B C D E

¶ The accompanying panoram
Pacific International Exposition
of the general advanced state o
ruary 20. The smaller pictures
1912, now occupied by the Ma
These pictures thus convey som
and of the colossal transformati
time.

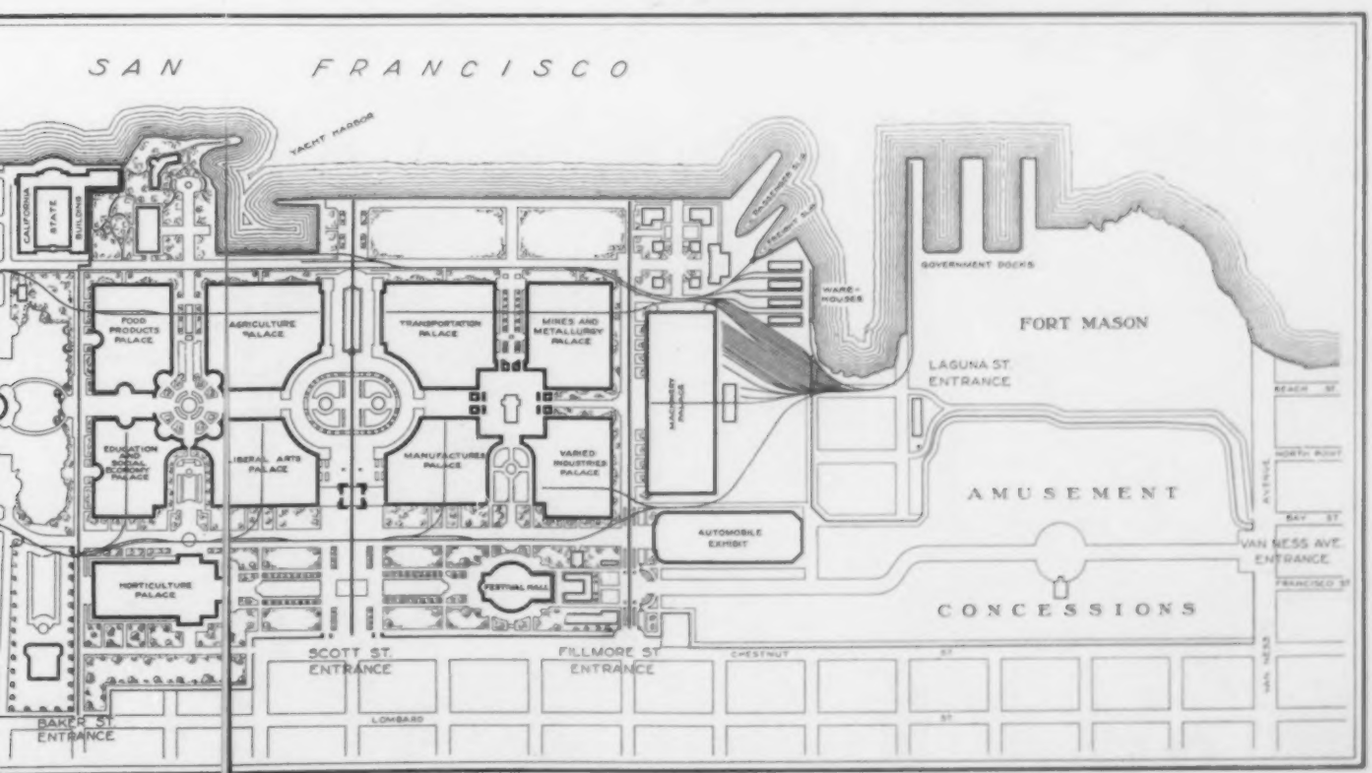
¶ The letters under the pano
identify some of the main bu
Products Palace; C, Education a
Palace; E, Horticulture Palace
Palace; G, Tower of Jewels, h
Transportation Palace; H, Manu
Palace; J, Varied Industries Pal



E F G H I J K L

rama of the main buildings of the Panama ition, taken some weeks ago, is an indication ate of preparedness for the opening date, Feb- ures show the condition of the site in August, Machinery Palace and other large buildings. some impression of the engineering involved, rmation which has taken place in a very short

panorama, together with the map, serve to n buildings: A, Fine Arts Palace; B, Food ion and Social Economy Palace; D, Agriculture alace, with its Glass Dome; F, Liberal Arts ls, hidden behind which is the dome of the Manufactures Palace; I, Mines and Metallurgy s Palace; K, Festival Hall; L, Machinery Hall.



SOME 26 MILES OF SEWERS

The exposition grounds contain 26 miles of newly constructed sewers. Ample provision is made for handling both sanitary sewage and storm water. Calculations based on the San Francisco rainfall rate curve and the areas of roofs, streets, paved courts and gardens, allowing proper percentages of runoff in each case, showed the sizes of pipes required to dispose of storm water. For the central and eastern portion of the Exposition a combined system of sanitary and storm sewers is installed. This system discharges into a large city outfall sewer the mouth of which is on the Exposition water front. The outlet is however well below extreme low tide and a considerable distance out from the sea wall, so that sewage is carried away by the tide stream and does not foul the surface. For the westerly portion of the Exposition separate storm and sanitary sewers were provided. The comparatively low elevation of this district necessitated a pump to handle the sanitary sewage to the outfall. The storm water could be carried directly to the bay.

Either second quality vitrified tile or wood stave pipe was used in sewer construction as circumstances warranted. It was thought advisable to use the latter for sanitary sewers whose discharge was to be handled by pumps in order to eliminate leakage of ground water. In districts covered by recent dredger fill, the elastic quality of the wood stave pipe and consequent freedom from broken joints with settling, was the determining factor.

Electric power and light are distributed through a network of underground conduits with conveniently located manholes. For the exhibit palaces there is a four-wire 60-cycle 3-phase 115-volt light service; for other buildings a three-wire 60-cycle single-phase service with 230 volts between outside conductors and 115 volts between outside conductor and neutral. Power is supplied where required on a 60-cycle 3-phase and single-phase 230-volt service. In addition to alternating current, the Palaces of Machinery, Mines and Metallurgy, Transportation, Varied Industries and Manufactures are supplied with direct current at 125 and 250 volts. The alternating-current power and light distribution system is operated at 4000 volts. Step down transformers are placed in inconspicuous fire proof vaults. A separate system supplies 11,000-volt alternating current to motor generator sets that furnish direct current. The size of conductors is such as to permit overlapping of the light and power loads on dark days. As previously stated the distribution system is underground. There are no unsightly poles.

NEW LIGHTING FEATURES

The lighting of exposition grounds and buildings is unique. Recent developments in filament and arc lamps have made it possible to secure effects unavailable at previous world's fairs. In general the lighting is indirect. Gas arcs, screened from the eye by banners and covered with specially designed diffusing globes, throw a soft warm light over the facades. Concealed high-power filament lamps covered with colored screens light the towers and sculptured features so that they appear semi-transparent. Windows are of chipped or translucent glass. Incandescent lamps behind them dispel the gloom of shadows and give the appearance of life and warmth within.

On the water front there is a small pier on which is located a battery of forty-eight 36-in. search lights, aggregating 2,600,000,000 candle power. Screened with colored glass, these will cast a glowing aurora over the buildings and upon natural or artificial fog. The Tower of Jewels, 450 ft. high, is covered with clusters of cut crystals in many colors. These in the rays of concealed search lights scintillate with wonderful beauty. The auditorium of Festival Hall is lighted solely by a battery of search lights placed below the floor at the center of the building. The rays are directed through an elevated diffusing screen so that although there is but a single source, no ray or source of light is visible. Where it has been necessary to use direct lighting, light sources of great intrinsic brilliancy have been screened with diffusing globes.

While the purpose of this article is to give briefly an idea of the nature and scope of the engineering that has been applied to the exposition construction, it would be unfair to make no further reference to the decorative and esthetic side. Approached either by night or by day and from any direction, the Exposition is a pleasing and beautiful spectacle. The architecture is somewhat varied in style, but connecting links blend various structures into a harmonious whole. Colors and decorations are not garish. Soft gray, pink, yellow and pale green predominate, with here and there stencils, frescoes and mural paintings in deeper tones that relieve any tendency to monotony. Tall trees and shrubs are banked against flat walls. Avenues and courts are lined with palms. Formal and informal gardens are glowing with yellow pansies and flowering bulbs. Along the water front there is a broad expanse of green lawn. Enclosing the grounds on the south side is a high wall. This is covered on both sides with shallow boxes, set on edge, of flowering mesembryanthemum, gray green or pink, according to the season.

Despite the European war it is assured that there will be little falling off from the expected official foreign participation. Twenty-five foreign countries as well as 30 American states are represented. Two months before the opening date exhibits were being installed. To the readers of this journal, the exhibits in the Palace of Machinery and Mines and Metallurgy will doubtless be of chief interest. A number will be unusual. More than two months ago the United States Steel Corporation began erecting its $150,000 display. This exhibit was described in *The Iron Age* of December 17.

The writer desires to voice his appreciation of the courtesy shown him by A. M. Markwart and E. E. Carpenter, of the Division of Works of the Exposition, in furnishing the information and the illustrations for this article.

The Athol Machine Company, Athol, Mass., issues a general invitation to visit and inspect the home of the Athol vise, and then have an opportunity of seeing that the company not only believes in "safety first," but "safety all the time." After visitors have looked over the office and factory, the workmen will be glad to have an inspection made of their clubroom.

The Hendey Machine Company, Torrington, Conn., announces that in connection with changes made in its selling arrangements it has established three branch offices, located as follows: Boston, at 141 Milk street, Oliver Building; New York, at 85 Liberty street, Singer Building; Chicago, at 565 Washington boulevard, Sharples Building.

The Fulton Drop Forge Company, Canal Fulton, Ohio, has received a large export order for drop forgings for hubs for commissary wagons for one of the countries at war.

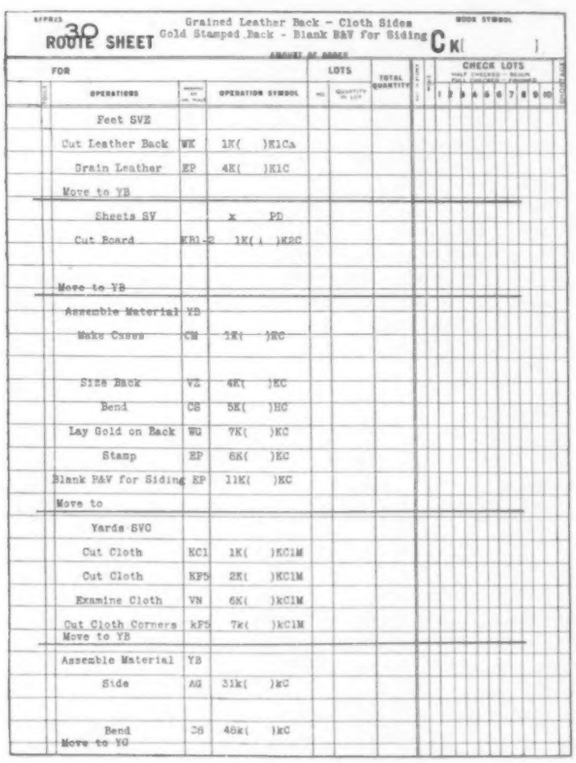
Scientific Management in the Office

How Time Studies and Task Setting in Duplication Work Have Succeeded—Schedules for Executives—Basis for Bonus Payments for Messengers

BY ROBERT T. KENT

To obtain a full comprehension of the requisites for applying the principles of scientific management to office work, we must first consider carefully the definition of scientific management. Taylor, the father of the science, thus defines it:

"Each man in the establishment, high or low, should daily have a clearly defined task laid out before him. This task should not in the least degree be vague nor indefinite, but should be circumscribed carefully and completely, and should not be



30 ROUTE SHEET — Grained Leather Back - Cloth Sides; Gold Stamped Back - Blank BAV for Siding — Book Symbol CK[

	Operations		Operation Symbol
	Feet SVE		
	Cut Leather Back	WK	1K( )K1Ca
	Grain Leather	EP	4K( )K1C
	Move to YB		
	Sheets SV		x PD
	Cut Board	KR1-2	1K( ) KR2C
	Move to YB		
	Assemble Material	YB	
	Make Cases	CH	2K( )KC
	Size Back	VZ	4K( )KC
	Bend	CS	5K( )KC
	Lay Gold on Back	WG	7K( )KC
	Stamp	EP	8K( )KC
	Blank BAV for Siding	EP	11K( )KC
	Move to		
	Yards SVC		
	Cut Cloth	KC1	1K( )KC1M
	Cut Cloth	KF5	2K( )KC1M
	Examine Cloth	VN	6K( )KC1M
	Cut Cloth Corners	KF5	7K( )KC1M
	Move to YB		
	Assemble Material	YB	
	Side	AG	31k( )KC
	Bend	CS	46K( )KC
	Move to YG		

Fig. 1—A Typical Route Sheet, Giving a List of Material, the List of the Operations to be Covered, the Machine or Location for Each Step, etc.

easy to accomplish. Each man's task should call for a full day's work, and at the same time the workman should be given such conditions and appliances as will enable him to accomplish his task with certainty." To these Taylor adds a high rate of pay for the accomplishment of the task and a correspondingly low rate for failure to accomplish it.

It has been contended by many who are unfamiliar with the possibilities of scientific management that there are many lines of human endeavor to which the principles established by Taylor cannot be successfully applied. Office work has long been held to be one of these lines, on account of the variety and irregular character of the work. If one will remember that there are many lines of work which present far greater variety, irregularity and complexity—notably machine shop work—than does office work, he will see that this objection is not well founded. If he will also bear in mind the fact that scientific management first analyzes every job into its elements and then selects those elements which make an efficient operation, he will soon realize that office work possesses the same possibilities for efficient task setting that any industry does.

Let us consider for a moment the characteristics of office work, and study them in the light of Taylor's definition quoted above. We will then examine a case where these principles have been applied in a busy factory office with a startling reduction in the time and expense of the purely administrative end of the factory operation. Office work today can be generally divided into two classes: *a*—routine work; *b*—miscellaneous work, irregular in volume, character and time of occurrence. Under the routine work may be included such work as the making of bookkeeping entries, filing, the making out of job tickets for the factory, the sorting of these tickets for the cost department and payroll clerks after they have been returned at the completion of the job, the making out and issue of requisitions for material, purchase orders, material tags and the hundred and one tickets and orders required today by modern factory conditions. In the miscellaneous division may fall correspondence, messenger service and all work which is subject to more or less interruption.

TIME STUDIES ON THE BOOKKEEPER

For routine work it is comparatively easy to fulfill the first condition laid down in the definition above—setting of a definite daily task. The foundation stone of all good management is time study—the analysis of a job into its elements—and a study on a skilled worker of the time required for these elements by means of a stop watch in the hands of a competent observer. By means of this time study it is easy to ascertain how long it should take to make a definite number of entries, for instance, on the standard work order used in the factory. This time study should extend over a sufficient length of time and cover a sufficiently large number of work orders to eliminate all the variables and to enable a definite standard time to be established.

Having taken this preliminary step, the office manager is then in a position to state, without fear of contradiction, what is a fair day's work for a clerk whose whole duty is the making out of work orders. He is also able to do more than this. Knowing the number of work orders that are to be made out in any one day he can definitely fix the length of time that the clerk should consume in writing them. If the volume of work orders on hand at the beginning of the day is insufficient to completely fill the clerk's time, he can lay out other work for the clerk to be performed at the completion of his preparation of the work orders, and the head can also know at just what time the clerk can begin the performance of this new task. Experience has proved that setting of definite tasks in this manner has worked wonders in reducing the number of persons required for the purely clerical end of the factory, and it has also resulted in work being performed with the regularity and promptness of a railroad schedule. Promptness in the work of the office means prompt starting of work in the shop. Every day saved in beginning an order

means just so much less trouble in making delivery on the promised date, and a reputation for prompt deliveries is an invaluable asset to any manufacturer.

ESTABLISHING THE ONE BEST METHOD

It is almost unnecessary to state that the accomplishment of a task set by time study, either in the office or the factory, calls for the same conditions in the performance of work as existed when the time study was made. This leads to the second requirement of the definition of scientific management—standardized conditions. The time study will doubtless reveal many inefficiencies in the present method of working, and from the revelations the "one best way" can be developed. This best method having been ascertained, it can be fixed and standardized by the reducing of it to writing, either in the form of a standing order or an instruction card, which gives in minute detail every step of the work, together with the time required for the various steps. Any failure, then, to accomplish the task can be investigated and the reason located by a comparison of the method used by the worker, with the standard method. Several instances of the establishment of standard methods are given below.

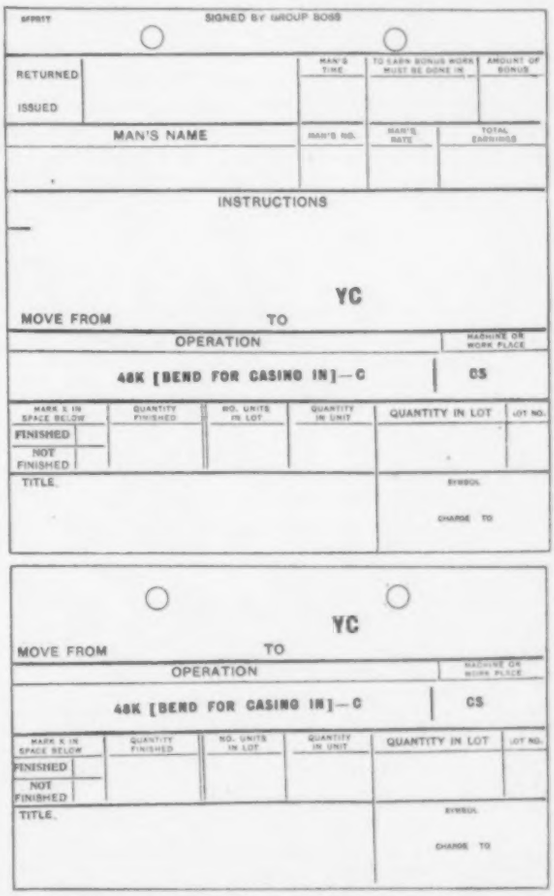
Miscellaneous work can be handled in several ways. A schedule of duties can be laid down, showing the order in which the various classes of work should be performed, and if possible the approximate time of day at which each set of duties should be finished. An instance of where this is done is the messenger service of the factory. The messenger has definite trips to make at certain hours of the day. The length of time occupied in each trip will necessarily vary with the volume of material to be handled, and the number of stops to be made. In between trips the messenger will have miscellaneous duties to perform. The time of beginning each trip can be definitely laid down, and the routine duties which he is to perform between trips can be enumerated and set for completion before the beginning of the next trip. It is unnecessary to set tasks for the performance of these miscellaneous jobs, since they are to be done in time which otherwise would not be employed. It is sufficient to specify the time at which they are to be completed.

Another class which will come under the head of miscellaneous work is that where the clerk has certain routine duties to perform, but which are subject to more or less interruption. For the routine duties, definite tasks can be assigned, and the employee can be credited with the time lost by the interruption. If the interruption consists of work of such character that it is susceptible of predetermination as to the length of time it will require, the credit may be made to conform to this predetermined time, else the employee will be considered to have failed in his task, and will thereby incur the penalty of loss of his higher rate of pay. Specific instances of all the above-mentioned methods of handling miscellaneous work will be cited hereafter.

Having now considered the general case of the application of the principles of scientific management to office work, we can now examine a specific case. The Plimpton Press, Norwood, Mass., has operated under the Taylor system for a number of years. At first, the workings of the system were confined to certain departments of the factory. The scope of the work under scientific management, however, was gradually extended until every department was so operated, with a marked reduction in the cost of production and a corresponding increase in the earnings of the workers. An analysis of the work carried on in the planning room of the factory and in the general office led to the conclusion that the same principles which governed the operation of the factory could also be successfully applied to the work of the planning room and office. The result of the attempt to apply scientific management in these departments amply justified all expectations.

THE SCOPE OF PLANNING ROOM WORK

The work of the planning room in the Plimpton Press corresponds to the work carried on in the usual factory office. It involves the writing of operation orders or job tickets; the making out of bills of material; the routing of work to the dif-



Figs. 2 and 3—The One is the Workman's Job Ticket and the Other Goes on the Shop Bulletin. Another Card Like the Larger Goes to the Planning Room Bulletin

ferent work places and machines in the factory; the calculating of worker's time and earnings, and other similar duties. In addition, the planning room performs other functions which, as a rule, under the old style management are performed by the foreman in the shop, among them the setting of piece rates and the routing of work to the particular machines on which each job is to be done. It is evident that the greater part of this work is of a strictly clerical character and involves many repetitions of the same item.

In this connection it should be realized that planning room work is identical in the operations performed with general office work, and a task can therefore be set in the office with the same facility as it is in the planning room. Remembering that scientific management requires the establishment of definite tasks and the establishment of standard conditions, let us see how these conditions are fulfilled with respect to the clerical work of the planning room of the Plimpton Press.

The starting point of all the planning room work

is the route sheet, which governs the progress of every order through the factory. The form and function of the route sheet will be described in detail a little later.

The Plimpton Press is a book manufacturing establishment. It comprises two divisions, a printing plant and a bindery. These are, to all intents and purposes, two separate factories, although they are under the same roof. Each is operated by its own planning room, the two being tied together through the medium of the general office. For purposes of illustration we will here confine ourselves to the bindery planning room, and all route sheets, time cards, etc., will be drawn from the practice of that department.

THE ROUTE SHEET

A typical route sheet is shown in Fig. 1. Briefly, a route sheet is a list of the material required for a given lot of books, combined with a list of the operations through which a book must pass in the process of manufacture. It also shows the location or machine at which each operation is to be performed, and the sequence of the operations. In addition it carries other information of value to the planning room, but which it is unnecessary to describe for the purpose of this article. In the bindery the production of a book is completely described by a combination of two route sheets, one of which governs the body of the book, or the assembling of the printed pages, and the other the making of its binding or covers. The route sheet illustrated is typical of those used in this establishment. It has been developed to fit the needs of the particular problem of the bindery, and differs materially from the route sheet used in other industries.

For each style of binding a separate standard route sheet has been developed, and likewise for each type of body there is a standard routing. In all, there are about 60 standard route sheets in use, each one calling for different materials and a different set and sequence of operations.

This analyzing of the process of manufacture and reducing it to a set of standard operations has necessarily minimized the clerical labor of issuing the necessary orders to put work in process in the shop. The various route sheets are printed in advance in large quantities on the multigraph. When a manufacturing order is received in the planning room, it is only necessary for the head of the room to determine from the specifications what combination of route sheets is required to comply with the specification.

The process of preparing the route sheet consists of simply writing in the quantities of the various materials required, completing the operation symbol, and determining and writing the number of lots and quantity in each lot into which the order must be divided for convenience in handling in the factory. It is evident that any given route sheet will require a certain definite number of entries. The time necessary to make a route sheet entry has been accurately predetermined by time study. The number of entries to be made on each standard route sheet is also a known quantity. It has therefore been possible to prepare a table which gives the total time to be allowed for filling out any of the standard route sheets. Reference to this table enables the head of the planning room to set a definite time for the writing of the combination of route sheets which govern the production of any order which is to go through the factory. The method of issuing the tasks to the planning room force will be touched upon later.

PREPARING THE OPERATION ORDERS

The route sheet controls the preparation of the work or operation orders, which in turn govern the actual processes in the shop. Writing these operation orders is a purely clerical job, and the clerk obtains all the necessary information from the route sheet. The number of lots into which the complete order is divided determines the number of operation orders for each operation on each lot. There are six classes of operation orders, dealing with as many varieties of work. In general, these are written in triplicate, by means of carbon paper. A typical order is shown in Figs. 2 and 3. The first and third tickets are identical, and are used as the workman's job ticket and for the planning room bulletin. The second ticket, shown in Fig. 3, is used on the shop bulletin. The time required to make the entries upon operation orders has been determined by time study, and tasks can be set for the clerk writing them.

Table Giving Time for Writing Operation Tickets and Tags. Time in Minutes. Allow 10 per cent. for Set Work on Operation Ticket Work

No.	(3) Opp. Ticket Under 5000	(3) Opp. Ticket Over 5000	Single Ticket	Pasting Tk. Including YP Move0.	Sewing Tk. Including Tag	Assembling Lists	Bundle Tags Printed
1	.65		.20	1.00	.77	.32	.12
2	1.30		.40	2.00	1.54	.64	.24
3	1.95		.60	3.00	2.31	.96	.36
4	2.60		.80	4.00	3.08	1.28	.48
5	3.25		1.00	5.00	3.85	1.60	.60
6	3.90		1.20	6.00	4.62	1.92	.72
7	4.55		1.40	7.00	5.39	2.24	.84
8	5.20		1.60	8.00	6.16	2.56	.96
9	5.85		1.80	9.00	6.93	2.88	1.08
10	6.50		2.00	10.00	7.70	3.20	1.20
11	7.15		2.20	11.00	8.47	3.52	1.32
12	7.80		2.40	12.00	9.24	3.84	1.44
13	8.45		2.60	13.00	10.01	4.16	1.56
14	9.10		2.80	14.00	10.78	4.48	1.68
15	9.75		3.00	15.00	11.55	4.80	1.80

Fig. 4—Part of a Table for Setting Tasks for Writing Operation Tickets

The application of time study has resulted in a number of modifications in the office practice in this work and it is proposed to digress for a moment and follow these modifications and show how they were reached as a result of time study and an application of the principles of management. Scientific management has been well termed "labor saving management," and nowhere is the justice of this term more clearly illustrated than in the case in point. Being based upon time study, scientific management requires the actual analysis of every job into its fundamental elements and the writing down of these elements. As heretofore noted, this analysis and reduction of the present practice to writing, with the subsequent synthesis of the elements into a

"best method" seldom fails to reveal many economies of time and motion which can be effected by a slight or radical change in the methods at present in use. The value of this feature of elementary time study cannot be too strongly emphasized. In the case of the operation tickets under consideration exactly this thing happened.

The original operation tickets were made blank with the ruling as shown, and all entries were filled in with pen or pencil. The analysis of the work showed that a large proportion of the time required to make out the operation tickets was consumed in writing the same characters time after time for different orders. For instance, on practically every cloth-bound book order that went through the planning room the clerk had to write the operation, for example, "6K [examine cloth] — 1C". On the same ticket he was required to write the designation of the machines from and to which this particular lot was moved. When the time study revealed the amount of time required for these apparently simple and minor operations, it became obvious that the amount of work involved could be materially reduced by printing the operations at the same time the tickets themselves were printed, and also by printing the machine designations showing the moving of the material, and the machine designation showing where the work is to be performed.

see that the stamping was accurately placed, and the speed of stamping thereby was limited only by the dexterity of the clerk in manipulating the stamp and removing the stamped tickets.

It will be recognized that this latter development is really not a case of management, but a mechanical invention which might easily have been produced in the most unsystematic shop in existence. It should also be recognized, however, that this development came as a result of time study which showed the time-consuming operations on which it was advisable to concentrate attention to ascertain whether or not it was possible to perfect a method, mechanical or otherwise, which would reduce the time and labor at this particular point.

The other operations involved in the preparation of the work order consist in writing in the proper space the name and number of the man who is to do the work. This is done when the job is actually assigned and the ticket posted on the bulletin board which governs the progress of work through the shop. Being a clerical operation it is also susceptible of time study and of task setting.

SIMPLIFYING A ROUTINE JOB

At this point the process of simplifying the work of setting tasks in the planning room may be discussed. Each one of the 60 different route sheets

Time for Making Out Operation Tickets. (Figured from Standard Route Sheets.) (Case and Body Comb.)

Route Sheet Number	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
19*50, 51	17.28	20.48	27.60	30.80	42.46	45.66	52.78	55.98	67.64	70.84
19*52, 53	17.73	20.93	28.50	31.70	43.81	47.01	54.58	57.78	69.89	73.09
19*54, 57	18.58	21.78	30.20	33.40	46.36	49.56	57.98	61.18	74.14	73.26
19*55, 56	20.28	25.18	35.30	40.20	54.86	59.76	69.88	74.78	89.44	88.66
19*58, 59	17.93	21.13	28.90	32.10	44.41	47.61	55.38	58.58	70.89	74.09
19*60	18.90	22.10	30.19	33.39	46.02	49.22	57.31	60.51	73.14	76.34
20*50, 51	14.36	17.56	24.69	27.88	37.27	40.47	47.59	50.79	60.18	63.38
20*54, 57	15.66	18.86	27.29	30.48	41.17	44.37	52.79	55.99	66.68	65.80
20*55, 56	17.36	22.26	32.39	37.28	49.67	54.57	64.69	69.59	81.98	81.20
20*58, 59	15.01	18.21	25.99	29.18	39.22	42.42	50.19	53.39	63.43	66.63
20*60	15.98	19.18	27.28	30.47	40.83	44.03	52.12	55.32	65.68	68.88
21* See 17										
22*50, 51	20.86	27.31	37.68	44.13	60.02	66.47	76.84	83.29	99.18	97.79
22*52, 53	21.31	27.76	38.58	45.03	61.37	67.82	78.64	85.09	101.43	100.04
22*54, 57	22.16	28.61	40.28	46.73	63.92	70.37	82.04	88.49	105.68	100.21
22*55, 56	23.86	32.01	45.38	53.53	72.42	80.57	93.94	102.09	120.98	115.61
22*58, 59	21.51	27.96	38.98	45.43	61.97	68.42	79.44	85.89	102.43	101.04
22*60	22.48	28.93	40.27	46.72	63.58	70.03	81.37	87.82	104.68	103.29

Fig. 5—Part of a Table for Setting Tasks Corresponding to Any Combination of Route Sheets

The title of the book was stamped in the space shown by means of a rubber stamp set up from movable rubber type, but the symbol and the order to which the job was to be charged were written in the spaces provided for such purpose with a lead pencil. The time study showed that this writing with a pencil consumed an excessive amount of time compared with the time required for stamping the title of the book. As the symbol and the charge symbol were the same on all operation orders for a particular book, it immediately became evident that the time required for preparing operation orders would be much reduced if these symbols also were set up in rubber type and stamped on the order blank at the same time that the title was stamped. Accordingly this change in procedure was instituted, the result being that the preparation of an operation order, as a rule, has been reduced to the filling in of the blank space showing the quantity in the lot and the lot number. To insure the stamped title and symbols being placed in the exact location desired on the operation order, an ingenious machine was devised which enables the clerk to preserve the relative location of the stamp and operation order for the entire batch of orders being stamped. This also reduced the time of preparing orders, inasmuch as no attention was required to

calls for a different sequence and set of operation orders. Time studies have been made to ascertain the time required for writing one or more operation orders in each of the six classes.

The results of time studies have been tabulated, showing the time required for writing the varying numbers of operation orders necessary for any job. One such tabulation is shown in Fig. 4. This gives the time required for writing any of the six different classes of operation orders in quantities ranging from one to fifty-five. The complete table covers several similar pages, running the quantity of tickets up to several hundred, or as many as are likely to be required on any ordinary order going through the factory.

This was the first table prepared. In using it, the person setting the task was required to be familiar with the operations called for on the route sheet and to know at a glance how many tickets and what class of ticket had to be written for each operation shown on the route sheet. It was, therefore, necessary for this person to sum up, mentally or otherwise, the number of operation tickets of each class called for by a given route sheet and then to refer to the table, Fig. 4, to ascertain the time to allow for the preparation of the operation orders called for by the route sheet. As each class

of book manufactured necessitates the use of two route sheets, it is obvious that each order might require twelve separate additions and references to the table. With a large number of orders being handled in the planning room each day, it is evident that the setting of tasks for the operation order clerk might become burdensome. A study was, therefore, made to ascertain how this time might be reduced and the table, Fig. 5, resulted.

The first column of this table shows the different route sheets which may be combined to govern the production of any particular class of book. For instance, the first item in the first column indicates that route sheet No. 19 may be combined either with route sheet No. 50 or route sheet No. 51. The second column gives the time in minutes required for writing all the operation tickets for either of these combinations for a lot of 500 books. Similarly, the second line indicates the time required for writing all the operation tickets for a combination of route sheets Nos. 19 and 52, or route sheets Nos. 19 and 53 for varying quantities of books. The setting of a task, therefore, for the writing of operation orders has been reduced to its lowest terms. The head of the planning room now has only to ascertain the numbers of the two route sheets covering the production of any book and the quantity of books in the order, after which a single reference to the table will give him the time to allow for doing the work. Similar simplification has been carried out wherever there is repetitive work to be done.

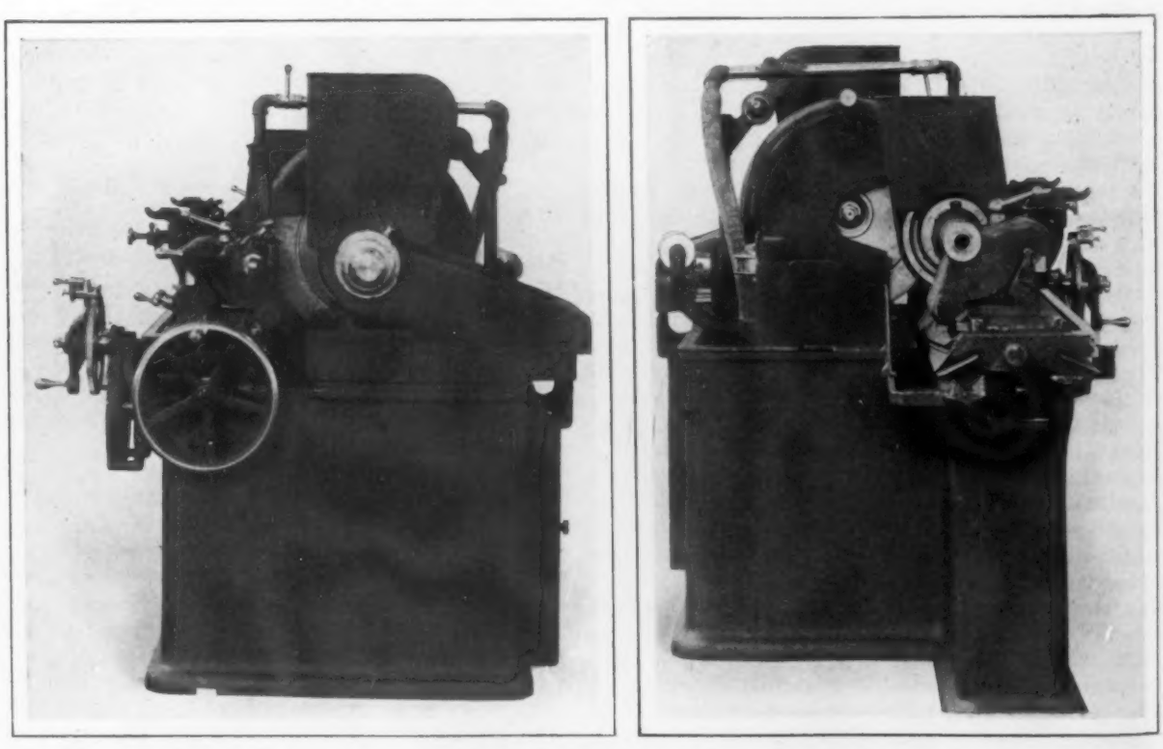
In handling work of this character operation orders are prepared for the clerks involved, similar to the orders issued to the shop and shown in Fig. 2. The various operation orders prepared for any particular clerk are exhibited on the bulletin board, and upon starting work the clerk stamps the time of issue upon it and also the time at which the work is finished, exactly as would be done by a workman in the shop. The elapsed time can then be computed in the accounting department and compared with the time allowed as written upon the order, to show whether or not the bonus has been earned. By consulting the bulletin board, on which there is a set of hooks for each worker, the exact amount of work ahead of any person can be ascertained, if desired, and the work apportioned to those clerks who have the least ahead of them.

(To be continued)

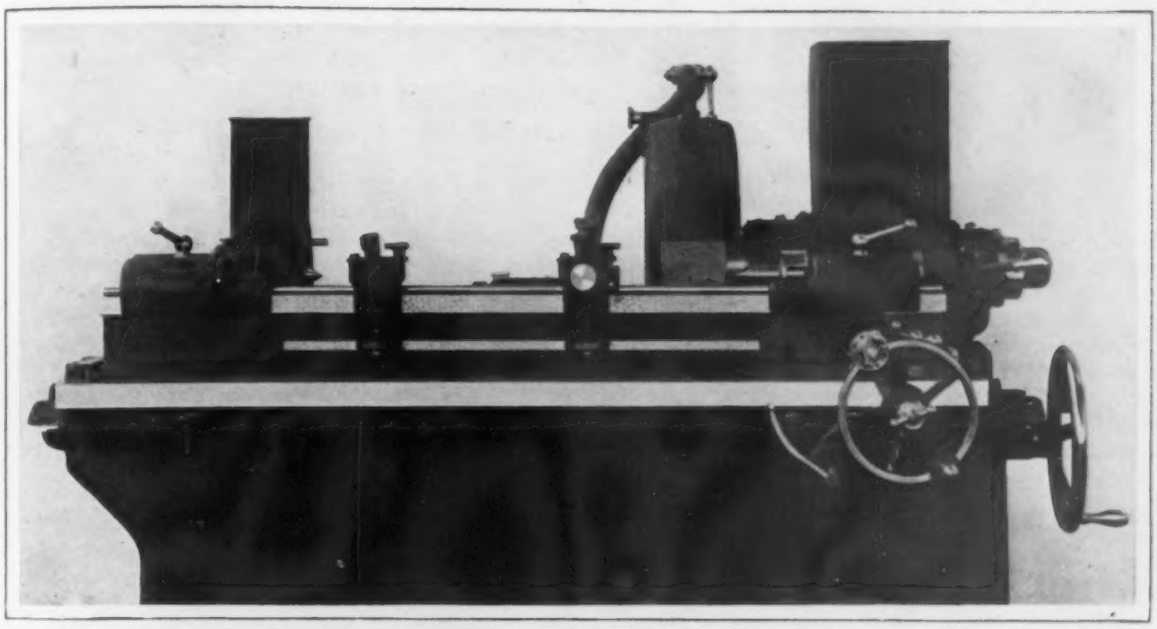
A Special-Purpose Grinding Machine

Originally Designed for the Ford Motor Company—Recently Made a Standard Type of the Norton Grinding Company

The Norton Grinding Company, Worcester, Mass., recently designed for the Ford Motor Company a new type of plain grinding machine. It is intended for wide wheel grinding and 33 have been installed in the Ford shops. All of these have the same swing, 10 in., but the length of the work handled varies, the distance between centers being 50 in. for 6 machines, 36 in. for 18, and 24 in. for the remaining 9. So satisfactory have been their results that the builder has adopted the machine as one of its standard types, and has named it the special-purpose plain grinding machine. The 36-in. size is the one illustrated and differs from the larger and smaller machines only in length.



End Views of the Machine. That at the Left, Which is the Right End of the Machine, Shows the Table Traverse Screw and Handwheel



Front View of a New Type Special-Purpose Plain Grinding Machine Employing the Wide Wheel Principle

The fundamental feature of the machine is that the work is done by a wheel the width of the surface to be ground. The wheel is fed straight into the work by hand until the desired diameter is obtained. No provision is made for automatic table traverse. The objective point in the design was the securing of a high degree of accuracy in the duplication of work, and at the same time very rapid production. The machine carries wheels 20 in. in diameter, and the limit of the grinding operation is a 7½-in. face wheel. Provision is made for utilizing as much as 40 hp. The wheel spindle pulley is 10 in. in diameter with a 6½-in. face and carries a 6-in. belt. Since there is but one spindle speed the wheels are furnished with a 12½-in. hole, which reduces materially the wheel cost.

To illustrate the manufacturing possibilities of this type of grinding machine, the net production of Ford transmission shafts is 550 in 8 hr. The rough grinding, removing 0.025 in. with a wheel having a 6⅛-in. face, gives an output of 1100 in that time. The finish grinding with the same face wheel, removing 0.005 in., develops an equal production. The total limit on diameter is 0.0005 in.

The Norton special-purpose grinding machine has the same wheel feed mechanism as the previous standard types, but no table traverse except by hand for grinding up to a shoulder when the nature of the work requires it and for truing the wheel. Power traverse is unnecessary as the width of the wheel determines the length of the cut. The hand traverse is accomplished in two ways. The screw feed, operated by the wheel at the right end of the base, is employed in truing the wheel and also in locating the work with reference to the wheel when the rack and pinion are out of use. When the horseshoe washer between the screw bearing and the hub of the handwheel is disconnected, the table can be traversed by the rack and pinion motion, controlled by the handwheel at the front of the machine, for locating the work correctly with reference to the wheel and in grinding to a shoulder. The latter motion is furnished usually for shoulder work only. Variation in length of work is taken care of entirely by the adjustment of the headstock which constitutes another variation from the standard Norton practice. The machine has a swivel table, and experience proves that tapers can be ground with entire success without table traverse. A centrifugal pump of simple design delivers 40 gal. of lubricant per min. over the wheel and the work.

The machine is admirably designed for the exact duplication of work. The back rest, which is of standard design, is provided with micrometer stops, while the wheel feed mechanism is arranged to measure to 0.00025-in. reduction in the diameter of the work. The back rest has a hardened steel shoe which supports the work. In setting the machine for grinding a lot of duplicate parts the first piece is ground to the required diameter. The micrometer stops are then set on both the horizontal and vertical screws of the backrest. With succeeding pieces the operator manipulates the backrest until the micrometer screws bring up against their stops and compensates for wear of the grinding wheel through the adjustment provided in the wheel feed mechanism. With a little experience the operator can turn out correct work, stopping only occasionally to use the micrometer. As there is no appreciable wear of the work shoe, by using the proper wheel he soon learns to know how often he must make correction for wheel wear.

The placing of the work in the machine is facilitated by an auxiliary backrest located close to the headstock. The operator places the piece to be ground on the shoe of this rest and that of the regular backrest, and it is then in line with the centers so that the action of the lever tailstock places it on the machine centers, ready for grinding. Another convenience in handling the work consists of brackets on the tops of the backrests, each having two grooves, which hold the blank while it is being dogged and awaiting its turn, and receive the finished piece while the blank is being placed on centers.

The truing of the wheel is made a simple operation. The truing device, which carries the diamond, is arranged to clamp to the table and accomplishes its task without interference with the backrest. The wheel slide is provided with so-called gibs to prevent lifting of the slide under a heavy cut. These are not contact gibs and are provided only as a precautionary measure.

The 50-in. machine weighs 7250 lb., the 36-in. 7150 lb., and the 24-in. 6400 lb.

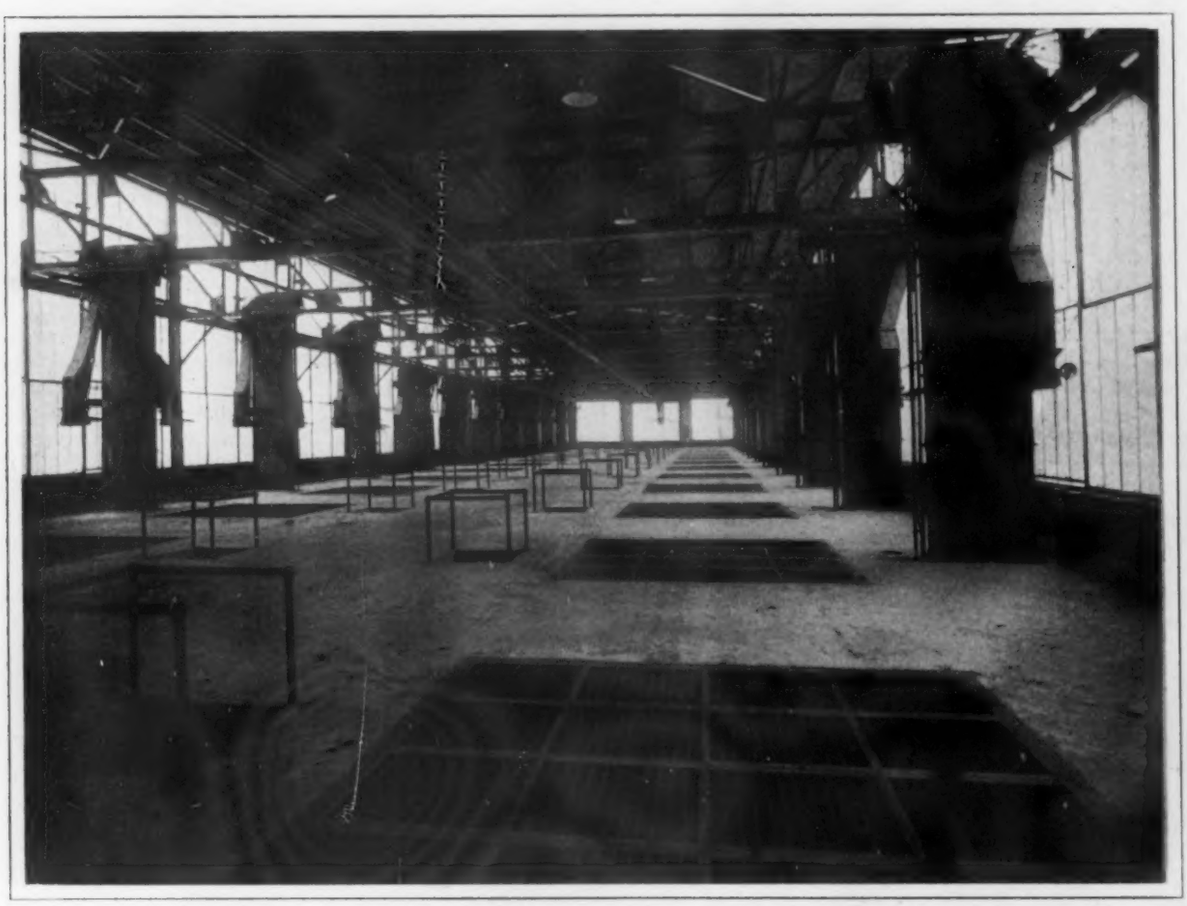
New Implement Foundry of Deere & Co.

A Gray-Iron Foundry of Two-Story Design at East Moline, Ill., Arranged for Continuous Melting Without Sacrifice of Flexibility

As a part of its harvester plant, completed last year at East Moline, Deere & Co. have built the first unit of a gray-iron foundry which presents a number of new features in building design and arrangement of mechanical equipment. In the continuously operated foundry the essential factors making up the complete cycle of operations are the handling of the sand, the making of the mold, the disposal, cooling and cleaning of the castings and the melting and distribution of metal. On the relation of these factors each to the other and to the work of the plant as a whole, the adaptability and smooth operation of the foundry largely depend. It has been found as a fault in the operation of some foundries where the service for the entire foundry is dependent upon mechanical equipment designed as a single unit, that this arrangement makes for too great rigidity with the possible result of crippling the whole plant through some minor defect. To preserve as great a degree of flexibility as possible the Deere foundry is arranged on a unit plan, each unit being self contained within each transverse bay of the foundry building, co-dependent with the other units only upon the overhead trolley which runs the full length of the molding floor for the delivery of hot metal. The design of all equipment is conspicuous for its simplicity.

The present unit is built in conformity with a general foundry plan which will meet the expanding needs of the company. This plan provides for two parallel two-story foundry buildings, each 600 ft. long by 60 ft. wide and connected at their mid-sections by a three-story cupola building. Between the buildings will be a yard for flask storage. On the opposite side of the one foundry building, of which the present building is a part, a service building is provided paralleling the foundry building and connected with it by passageway. On the far side of the other foundry building yard room is laid out for the storage of raw materials. The third or charging floor of the cupola building being on a level with the roof of the two-story foundry, the raw materials will be elevated in a yard elevator and brought across the roof of one foundry building over a runway to the cupola charging floor. The buildings now completed include a section of the first foundry building 360 ft. long, a part of the cupola building large enough to accommodate two cupolas and a section of the service building, 60 ft. wide and 120 ft. long.

The buildings are of reinforced concrete construction with steel roof trusses, the molding and cupola buildings having a beam floor construction



The Molding Floor Prior to Installation of Molding Machines, Showing Duplicate Sand Elevators, Shake-Out Grates and Cooling Reservoir Openings for the Castings

and the service building, flat slab. The second or molding floor is designed for a distributed load of 150 lb. per sq. ft. The particularly novel feature of the building design has to do with the roof construction and the full panelling of the side walls with glass. The roof is the inverted type, pitching from either side into a central gutter and covered with Federal concrete slabs and composition roofing. By this device the side wall lighting arear is increased by more than one-third. From a level 30 in. above the floor, counterbalanced sash of ribbed glass, surmounted by two panels of ventilating sash operated by the Pond continuous system, extend the full hight of the wall. The service building has a flat roof and double pivotal instead of counter balanced sash. The artificial lighting for the foundry using tungsten incandescent lamps, includes column sockets for lamp extensions for each molder.

on either side of the elevator, making up the molds and setting them out on the floor toward the center aisle from each side for pouring, pouring with hot metal delivered on the trolley which runs down through the center of the building, shaking the molds out over gratings inserted in the molding floor, through which the used sand drops back to the first floor bins directly under the bay in which the sand is used; dropping the rough castings through the floor openings into the cooling reservoir chute from which they slide into the tumbling barrels for cleaning, and delivering the castings by trolley for such machining as may be required.

The sand storage bins extend along both side walls of the foundry building on the first floor in a continuous row, one bin on each side to each bay. Each bin is divided by a partition paralleling the outside wall. On the wall side new sand is stored

Under Side of the Cast-Iron Segmental Cooling Reservoirs Hung from the Molding Floor and the Used Sand Return Spouts on Each Side

As indicated, each cross-sectional bay of the foundry building, comprising a floor space 20 x 60 ft. on the first and second floors, is equipped for the complete production of castings independently of the other bays. Views of the molding floor showing the arrangement of the equipment on this unit system are here shown. In each unit or bay the facilities for handling the sand are duplicated on each side of the building, the machines and floors for making the molds are duplicated in pairs on each side of the center aisle, and each side of the bay has an opening into the cooling slide on which the castings are carried to the cleaning plants on the first floor, arranged one for each bay.

In brief the scheme of unit operation in each bay consists in elevating the molding sand at each side of the building from the first floor bins, discharging it on the second floor to molding machines and on the inside the used sand which drops down from the molding floor above through a steel chute. The sides of this chute are inclined at 45 deg. and the discharge gate by which the hot sand is diverted from the cooled sand below is 6 ft. below the floor above. The used sand is wet down in this bin, hose connections being placed at each column, is cut over and allowed to temper. Through an opening in the bin partition this sand can be shoveled directly into the boot of the sand elevator which rises against the wall. The boot of the elevator is set down below the floor and sand is charged in through a mixing and cutting screw bladed device direct driven by motor. The proper proportion of new sand is added to the old sand through this mixer.

The sand elevator is the endless chain bucket type, housed in steel plate and driven by a 3-hp motor mounted as shown in the general views. The

The Castings Are Discharged from the Reservoir Directly Into the Tumblers from Which They Drop by Gravity to the Grinding Table

elevator rises above the second floor to the bottom chord of the roof trusses or about 15 ft., and at the top is equipped with a deflector gate, by means of which the sand can be discharged to either side. The housing is built to provide storage pockets on either side, each with a capacity of 1¾ cu. yd. Where the elevator is delivering sand to the floors on which the heavier work is put up, the sand drops from the storage pocket gate directly to the floor, whence it can be most easily shoveled into the mold by the molder. For the lighter work, the storage pocket is fitted at the bottom with a shoveling board, 18 in. above the floor and 18 in. wide. From this the machine operator can shovel his sand into his riddle without stooping over. The elevators have a capacity for delivering 1 cu. yd. of sand every 6 min., so that the time of actual operation of the elevator required for supplying the needs of the two machines which it serves is but a small fraction of the day, leaving a very large margin of safety in event that repairs are needed.

Molding Machines Are Located On Either Side of the Sand Elevators and Overhead Cranes Serve Each Molding Floor

Nearly all of the molds are made up on stripping plate machines; a few jobs are put on power squeezers, and for some, matchplates are now being developed. It is the practice to operate the two machines which flank the elevator in conjunction, making the cope half of a mold on one and the drag half on the other. When the adjacent molding floor is filled with molds the machines can be picked up by crane while the molds are being poured and transferred to another bay in which temporarily there may be no work in progress.

The cranes for this purpose are deserving of special comment. As shown in the general view they operate over the molding floor from the side wall to the center aisle on a runway of 18 ft. span hung from the roof trusses. They have a capacity of 3000 lb., but weigh only 850 lb. This extreme lightness is attained through the use of skeleton pressed steel wheels and a simple I-beam girder construction. The crane is mounted with roller bearings and moves along the runway so easily that no operating devices are necessary, a slight pressure at the hook being sufficient to move the crane at will under full load. An air hoist with 3-ft. lift is hung from the crane. The molds, after pouring, are shaken out on the grate before mentioned. This grate, flush with the floor, has an area 10 ft. square and is made up of cast iron checkers 30 in. square with 2-in. openings carried on I-beams hung across the opening. The sand falling through this grating is received in the chute below.

For the disposal of the castings thus shaken out openings are provided on each side of the center aisle or 10 ft. apart, each opening serving the pair of floors on each side of the bay. The view of the molding floor shows these holes guarded by railings, but these were subsequently removed and the

The General Equipment of the Core Room Showing One Section Looking Toward the Ovens, Which Are Partitioned Off As Shown

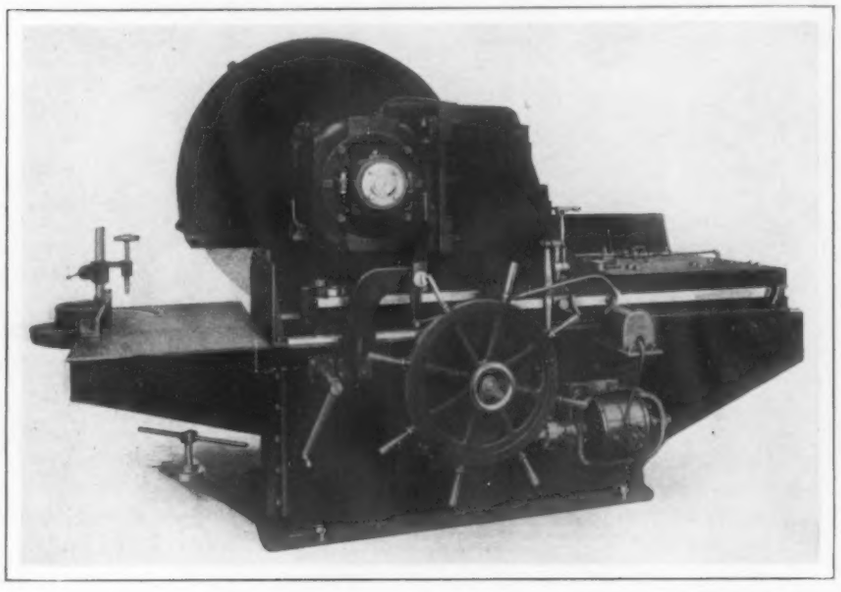
opening fitted with a cover. From each of these openings chutes built up of cast iron segments incline downward at an angle of 25 deg., converging also toward each other and uniting in a common landing table segment at the delivery end. The castings and gates are raked into these openings while still hot and drop onto the slides which are of such size and are inclined at such an angle as to act both as a storage and cooling reservoir. They will take the full production of the floors they serve for 5 hr. The slides from the floors on which the lighter work is made terminate above the platforms on the first floor, on which the tumbling barrels are mounted, at a hight suitable for raking the castings directly into the mill from the landing table. For the larger castings an extension is added to the chute which carries it down to within 3 ft. of the floor, affording the necessarily larger space for storage and the greater freedom in handling the pieces for cleaning. As mentioned in the preceding paragraph the tumbling barrels for the lighter castings are mounted on platforms in the center line of the first floor, the axis of the mill being at right angles to the casting slides. The elevation of the mill allows of handling the castings to the grinders on the first floor by gravity, and for this purpose the platform is equipped with dumping buckets which receive the castings from the tumblers and deliver them to a receiving basin, from which the grinder at his machine can pick them. Where the slide is extended the tumbler is placed on the floor at one side. The grinding machines are of special design, being single ended, the wheel on the one end balancing against the driving motor on the other end. A trolley from which roller bearing hooks are hung extends the full length of the cleaning room, and the cleaned castings are transferred on these trolley hooks to the machine shop in the service building, equipped for a few preliminary operations.

The melting equipment consists of two 90-in. cupolas lined down to an inside diameter, which yields a daily production of 70 tons of hot metal. With a thinner lining the melt can be brought up to 130 tons. Raw material is carried to the charging floor in charging buggies on an electric elevator from the yard and charged into the cupola through opposite doors. The cupolas are now operated continuously, each for half a day, melting about 45 tons. The hot metal is tapped as illustrated into a 2000-lb. ladle equipped with worm gear for tilting and suspended from a 4000-lb. electric trolley hoist, which delivers the iron to the molding floor. In order to release the trolley the ladle is set down on a floor standard for pouring and the metal is transferred to 50 and 100-lb. hand ladles for pouring the molds. The trolley meanwhile picks up an empty ladle and returns to the cupola for more metal.

Hot Metal is Received from the Cupola in Ladles Carried by a 4000-lb. Electric Trolley Hoist

Trolley cranes are being installed over some of the floors for pouring, the trolley runways being designed so that the hoists may be transferred from one bay to the next.

The core room is located on the second floor of the service building and has facilities for 25 coremakers with a floor 30 ft. square. A view of the benches is shown in an accompanying illustration. The coremakers' room is partitioned from the ovens by a sheet-steel partition with an opening at bench hight for the passing of the cores to the oven tender. The rooms for the ovens is 1200 sq. ft. in area and is ventilated through four circular stacks 3 ft. in diameter. The ovens are of special design with a fuel oil burner. They are built up in horizontal sections, each section having 6 shelves. The heat is distributed from the central combustion chamber at the bottom of the ovens across the bottom and rises on each side through the shelves carrying the cores.



A Recently Developed High-Speed Friction Saw for Cutting Rails and Various Structural Shapes

All cores are delivered into stock and from stock to the molding floor. For this purpose a storage room adjoins the oven room, in which pressed steel racks are installed, providing 1600 sq. ft. of shelf storage space. The racks are built in sections, each of which is labeled with the symbol number of the pattern with which the core is associated. The smaller cores are stored in sheet steel trays, and the larger cores are laid directly on the shelves. When required the molders get their own cores out of storage, the storage room being immediately adjacent to the molding floor.

Roller Bearings for Mill Equipment

The American Roller Bearing Company, Pittsburgh, Pa., which manufactures roller bearings for use in connection with iron and steel mill equipment, has supplied the following data on the performance of such bearings. A roll table, when equipped with plain bearings, required a 50 hp. motor. When roller bearings were used, it was found that a 35-hp. motor was more than ample for the service. The saving in power, due to the use of a smaller motor, was 15 hp. or 11.19 kw. Assuming the continuous service of the table as 6 hr. per day, the saving at 2 cents per kw.hr. figures out at $402 per year for 300 operating days. The table tested consists of 20 rolls. The elimination of lubrication, which the bearing does without, represents, it is added, a saving of $80 per year.

A High-Speed Friction Saw for Shapes

A high speed friction saw designed for cutting rails, beams, angles and other steel shapes has been placed on the market by Joseph T. Ryerson & Son, Chicago, Ill., this latest design being a development of this type of saw based upon that company's experience. This saw, known as No. 3 size, has a present interest arising out of a recent demand for it from Europe for use in ship building plants.

The saw is carried on a very heavy cast-iron box base, on top of which is mounted a horizontal sliding motor table, with a vertical extension used as a motor bracket, thus giving the motor what is commonly known as a wall mounting. The table operates horizontally on vertical rollers, horizontal rollers being provided to prevent a sidewise motion of the table. The work table is placed directly in front of the machine, separate from the base, and provision is made for its vertical adjustment, permitting the cutting of structural material in an upright position.

A particular feature of this equipment is the advantage of having it self-contained, with its own main driving motor and separate motor for feeding the carriage through the material. There are no gear or belt connections to get out of order. It is not necessary when straight cutting is being handled to use any additional labor in clamping the material to the work table, for the center line of the cutting blade being set higher than the work table, the blade as it is fed through the material, acts as an automatic clamping device.

A beveling attachment allows the work to be set to any bevel up to 45 deg. The main driving motor is of special design for heavy duty, having a nominal rating of 45 hp. When an electric feeding device is supplied, arrangement is made to provide automatic limit stops and return feed. The machine itself is operated by one man, the amount of labor required to move the material to and from the saw depending on the mechanical arrangements which the shop affords.

The rate of cutting is naturally very high for this machine, a 15-in. beam being handled in approximately 20 sec. actual cutting time. Numerous tests have shown that manganese and high-carbon steel rails can be as readily cut as structural shapes, the standard manganese rail requiring only 45 sec.

The following table gives the principal dimensions and specifications of the saw:

Maximum size of beams handled, in.	24
Maximum size of Bethlehem shapes handled, in.	18
Maximum size of H-beams handled, in.	12
Diameter of blade, in.	52
Length of stroke, in.	38
Distance between table and saw collar, in.	12¼
Vertical adjustment of table, in.	14½
Power required, hp.	45 to 90
Floor space required, in.	62 x 147
Over-all hight, ft.	7
Approximate weight, lb.	1200

This machine can be furnished for any type of current or voltage, and equipped with either hand-

wheel hydraulic, pneumatic or independent motor feed. With each machine are furnished motor and starting device complete, two blades, nicking chisel, mitering clamp and necessary wrenches, oil cups, etc.

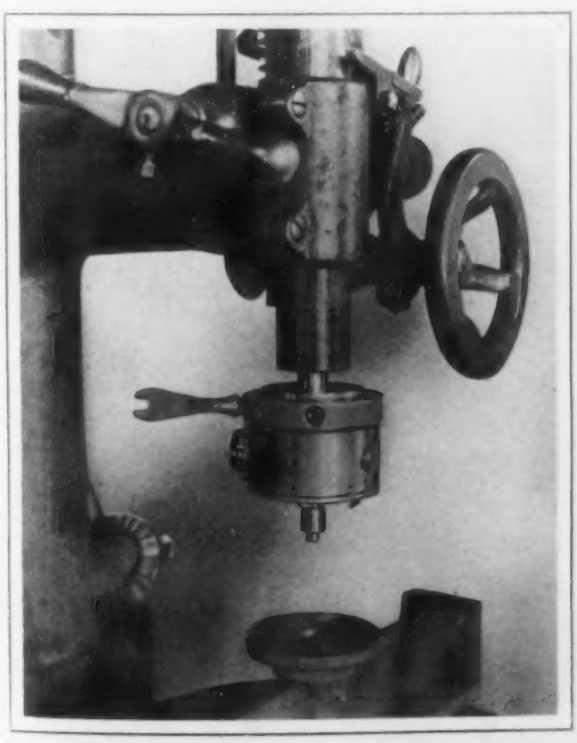
A Facing Tool for Drilling Machines

To enable facing work to be done on a milling or a vertical drilling machine, the Mummert-Dixon Company, Hanover, Pa., has brought out an automatic tool. It operates on the same principle as the facing of work on a lathe and uses an ordinary lathe tool bit. The ordinary flat spot-facing tools, it is pointed out, are hard to start because of the difficulty in getting under the scale of the casting. By the time the tool is forced through this hard surface coating of scale, the cutting edge is frequently damaged to such an extent that the tool must either be reground or replaced by a sharp one before the work can be finished.

The operation of the tool is simple. The feed is obtained by gripping the knurled ring with the hand and holding it, or a pin may be inserted in one of the holes in the ring and left to bear against the frame of the drilling machine. This operates the feed screw which moves the tool across the work in the same manner and at the same rate as would be done in a lathe. In this way, it is pointed out, the tool gets underneath the surface at the start and breaks the scale away as it is fed across the work.

Provision is made on the bottom faceplate for the attachment of a pilot. This enters the hole in the boss which is to be faced and is relied upon to steady the tool. Thimbles to fit any ordinary size of hole can be placed on this pilot. In addition there is a drill pilot which is used where there is no hole in the surface of the work to be machined. With this pilot it is pointed out that it is simply necessary to place the attachment on the work and start the tool. The drill will make the center hole and keep the tool in position until the facing operation is completed. In addition to being used in a vertical drilling machine, the tool can also be used on a milling machine or a boring mill. As these tools have a rigid spindle it is found unnecessary to employ either pilot with them.

Two sizes of the tool which will face a boss or a surface, having a maximum diameter of either 4 or 6 in., are provided. A shank conforming to the Morse taper is provided for the tool which in this way will fit any drilling machine spindle. The shanks can be supplied to conform to either the No. 3, 4 or 5 taper.



A Recently Developed Milling and Vertical Drilling Machine Tool in Use for Facing

Electrical Developments in the Year

In the year just closed the advance along electrical lines has been confined, according to the Westinghouse Electric & Mfg. Company, to extensions of existing standards rather than exhibiting any new or startling discoveries or inventions. The gradually increasing size of generating units has continued until the installation of a 35,000-kw. turbo-generating set is a possibility, while a few years ago a 10,000-kw. set was considered the limit in the way of size.

Closely akin to the increasing size of the generating units is the continued growth of high-tension voltages for transmission purposes, an example of which is the Pacific Light & Power Company in California, where a potential of 150,000 volts is used. Transformers of the self-cooling type are now being built up to 5000-kva. capacity of sheet steel, equipped with external radiators. The cases of these transformers are made oil-tight by oxy-acetylene welding process. The air-blast transformer has also reached a size of 5500-kva. single-phase unit, designed for operation on a 25-cycle circuit. In 1914 several 24,000-ampere carbon-type circuit breakers were put into service, these being the largest capacity circuit breakers of any kind ever built.

ELECTRICITY IN STEEL MILLS

The use of electricity in steel mills has continued. A large number of direct-current motors have been connected to the rolls for producing hoops by the Sharon Steel Hoop Company, a class of work which was previously performed by alternating-current motors. A particularly noticeable fact was the adoption of central station power by the steel mills, coal companies and railroads for work in their respective lines and especially for work at terminals by the latter two. A number of steel companies have installed electric furnaces, and railroads, steel foundries and mills, and more especially machine shops, have taken quite an active interest in the subject of arc welding.

The use of electricity in the automobile is one of the modern developments which has grown rapidly. At first electricity was only used in the automobile for ignition. Now the charges are not only ignited electrically, but the car is equipped with electric lights, an electric motor for starting the engine and electrical devices for shifting the gears. The single machine with a single armature and single commutator which may be used either as a motor for starting the engines or as a generator for charging the storage battery, is a development of the year. Another development is the magnetic pinion shift whereby the starting motor is thrown into gear by a magnetic device instead of a manually-operated one.

Maximum Prices for Metals in Germany

The maximum prices for some of the non-ferrous metals have now been fixed by the German Government, the prospect of which was announced in *The Iron Age*, December 10, 1914. The maximum prices fixed for copper, aluminum, antimony and tin are shown in the following table, which also gives a comparison with the November and ante-war prices per metric ton:

	Maximum, Dec. 14, 1914	Price Nov. 21, 1914	Price in July, 1914
Copper	$486.65	$535.31	$296.85 to 311.45
Aluminum	787.37	1,094.96 to 1,216.62	389.32
Antimony	364.98	486.65	109.49
Tin (all grades)	1,155.79	.....	734.84 to 744.57

Maximum prices for lead and nickel are to be announced later.

The Electric Steel Industry's Present Status

A Review of the Progress Since 1910 —Remarkable Expansion in the United States—213 Furnaces in the World

Progress in the electric steel industry has been more pronounced in the last year or so than is probably generally realized. In *The Iron Age* of April 14, 1910, a list of the installations of electric furnaces producing steel in the European and American plants early in 1910 was printed as compiled by Stahl und Eisen. This showed a grand total of 114 such furnaces in the world. In its issue of July 10, 1913, *The Iron Age* again presented tables showing, in a general way, the status as of July 1, 1913. Those figures placed the total number of electric furnaces in the world at 140. In this issue are published extensive tables to show the location, type, product and capacity of all the furnaces, operating or building, in the world, showing a grand total of 213, or an increase of nearly 100 per cent. since early in 1910 and 50 per cent. since early in 1913, or in two years.

The following tables are based on data furnished by the technical department of the United States Steel Corporation and are regarded as entirely authoritative, corroborated by data collected by *The Iron Age* so far as the industry in the United States is concerned. Tables 1, 2 and 3 give the location, size, character, product, capacity, etc., of the Heroult, Girod and induction furnaces respectively in the world. Table 4 shows miscellaneous electric furnaces in Europe only, outside of the Heroult, Girod and induction types, based on literature on the subject and hence is not vouched for as to its entire accuracy. Table 5 gives all the electric furnaces, other than Heroult, Girod and induction in the United States and Canada.

Table 1. Heroult Electric Furnaces, Operating or Building, January 1, 1915

Company	Location	Size of furnace in tons		Basic or acid	Current phase	Charge	Material produced	Capacity per year, tons
		Building	Operating					
GERMANY								
Stahlwerke Richard Lindenberg A. G.	Remscheid-Hasten	.....	2½	Basic	Single	Cold scrap	Tool steel, structural steel, war material	2,250
Ditto	Ditto	.....	3	Acid	Single	O. H. metal	Ditto	9,000
Bismarckhuette	Bismarckhuette O.S.	.....	1	Basic	Single	Cold scrap and O. H. metal	War material, high silicon, dynamo sheets, locomotive tires	1,200
Ditto	Ditto	.....	3	Basic	Single	Ditto	Ditto	3,600
Ditto	Ditto	10	.....	Acid	Single	O. H. metal	High silicon, dynamo sheets	24,000
Mannesmannroeherenwerke	Saarbrucken	.....	3	Basic	Single	Cold scrap	Seamless tubes, castings	2,700
Gewerkschaft Deutscher Kaiser	Bruckhausen	.....	7	Acid	Single	O. H. and basic Bessemer metal	Rails, seamless tubes, structural material and high silicon dynamo sheets	22,000
Ditto	Ditto	.....	7	Acid	Single	Ditto	Ditto	22,000
Ditto	Ditto	.....	28	Basic	Three	Ditto	Ditto	90,000
Ditto	Ditto	.....	7	Acid	Three	Basic Bessemer metal	Castings	12,000
Ditto	Ditto	.....	7	Basic	Three	Ferromanganese	Molten ferromanganese for Bessemer	.....
Stahlwerk Thyssen	Hagendingen (Lothringen)	.....	7	Acid	Three	Basic Bessemer metal	Castings	12,000
Ditto	Ditto	.....	7	Basic	Three	Ferromanganese	Molten ferromanganese for Bessemer	.....
Rombacher Huttenwerke	Rombach (Lothringen)	.....	3	Basic	Single	Basic Bessemer metal	Rails, wire	10,000
Dortmunder Union	Dortmund	.....	7	Basic	Three	Basic Bessemer metal	Rails, axles and tires	25,000
Ditto	Ditto	.....	7	Acid	Three	Ditto	Ditto	30,000
Ditto	Ditto	30	.....	Basic	Three	Ditto	Ditto	120,000
Gelsenkirchen Bergwerks	Esch	.....	4	Basic	Three	Ferromanganese	Molten ferromanganese for Bessemer	.....
TOTAL IN GERMANY: Operating, 16; Building, 2; Yearly capacity, 385,750 tons								
LUXEMBURG								
Felten & Guilleaume	Luxemburg	10	.....	Acid	Single	Basic Bessemer metal	Wire	40,000
TOTAL IN LUXEMBURG: Building, 1; Yearly capacity, 40,000 tons								
AUSTRIA								
Gebr. Boehler Company	Kapfenberg	.....	4	Basic	Single	Cold scrap and molten metal	Structural steel, tool steel and war materia l	4,500
Ditto	Ditto	5	.....	Basic	Single	Ditto	Ditto	5,000
Danner & Company	Judenburg	.....	2	Basic	Single	Cold scrap	Ditto	1,500
Kaerntr. Eisen and Stahlwerksges	Kaernten	.....	5	Basic	Single	Cold scrap	Wire rods	4,500
Brueder Lapp	Rottenmann	.....	6	Basic	Single	Cold scrap	Dynamo and stamping sheets, seamless tube s	6,000
Witkowitzer Berg-Bau & Eisenhutten Gew	Witkowitz	.....	7	Acid	Three	O. H. metal	Castings	25,000
Ditto	Ditto	.....	2	Basic	Three	Ferromanganese	Molten ferromanganese for open-hearth	.....
TOTAL IN AUSTRIA: Operating, 6; Building, 1; Yearly capacity, 46,500 tons								
HUNGARY								
Kgl. Ungar. Eisen & Stahlwerk	Diosgyoer	.....	2	Basic	Three	Cold scrap	War material	1,500
Manfred Weiss A. G.	Budapest	6	.....	.....	.....	Cold scrap and O. H. metal	Projectiles	9,000
De Litzpak A. G.	Ditto	3	.....	.....	.....	Ditto	Castings	4,500
TOTAL IN HUNGARY: Operating, 1; Building, 2; Yearly capacity, 15,000 tons								
ITALY								
Societa Tubi Mannesmann	Dalmine	.....	6	Basic	Single	Cold scrap	Seamless tubes	5,500
Ditto	Ditto	.....	6	Basic	Single	Ditto	Ditto	5,500
Ditto	Ditto	.....	15	Acid	Three	Ditto	Ditto	15,000
Ditto	Ditto	.....	15	Acid	Three	Ditto	Ditto	15,000
TOTAL IN ITALY: Operating, 4; Yearly capacity, 41,000 tons,								

Table 1. Heroult Electric Furnaces, Operating or Building, January 1, 1915—Concluded

Company	Location	Size of furnace in tons: Building	Size of furnace in tons: Operating	Basic or acid	Current phase	Charge	Material produced	Capacity per year, tons
SWITZERLAND								
G. Fischer	Schaffhausen	.....	1	Basic	Single	Cold scrap	Castings	2,500
TOTAL IN SWITZERLAND: Operating, 1; Yearly capacity 2,500 tons								
FRANCE								
Ste. Electrometallurgique Francaise	La Praz	.....	3	Basic	Single	Cold scrap	Tool steel	2,500
Acieries du Saut du Tarn	St. Juery	.....	5	Basic	Single	Ditto	Ditto	4,500
Ste. de la Basse Loir	Trignac	5	.....	Basic	Single	Ditto	Ditto	4,500
Hauts Fornaux et Acieries de Caen	Caen	5	.....	....	....	Basic-Bessemer metal	Ditto	15,000
Ditto	Ditto	5	.....	....	....	Ditto	Ditto	15,000
Ditto	Ditto	25	.....	....	....	Ditto	Ditto	75,000
Ditto	Ditto	25	.....	....	....	Ditto	Ditto	75,000
Acieries electrique de Paris et de la Seine	Ditto	2½	.....	....	....	Cold scrap	Castings	3,000
TOTAL IN FRANCE: Operating, 2; Building, 6; Yearly capacity, 194,500 tons								
ENGLAND								
Edgar Allen Company	Sheffield	.....	3	Basic	Single	O. H. metal	Tool steel	7,500
Edgar Allen Company	Sheffield	3	.....	Basic	Single	O. H. metal	Tool steel	7,500
Vickers Sons & Maxim	Sheffield	.....	2½	Basic	Single	Cold scrap	Tool steel, war material	3,000
Thomas Firth & Sons	Sheffield	.....	2½	Basic	Single	Cold scrap	Tool steel	3,000
Vickers Sons & Maxim	Sheffield	.....	6	Basic	Single	Cold scrap	Tool steel, war material	9,000
Lake & Elliott	Braintree	.....	2	Basic	Single	Cold scrap	Castings	2,000
The Skinningrove Iron Company	Carlin Howe	15	.....	Basic	Three	Talbot metal	Billets	45,000
TOTAL IN ENGLAND: Operating, 5; Building, 2; Yearly capacity, 77,000 tons								
BELGIUM								
Ste. An. du Hainaut	Couillet	5	.....	Basic	Single	O. H. metal	Castings	15,000
Ste. an. d'Ougree	Marihaye	.....	5	Basic	Single	O. H. metal	Billets	15,000
TOTAL IN BELGIUM: Operating, 1; Building, 1; Yearly capacity, 30,000 tons								
RUSSIA								
Obuchow'sche Steel Works	St. Petersburg	.....	3½	Basic	Single	O. H. metal	Marine and war materia	10,000
Makiewka Steel Works	Makiewka	.....	3½	Basic	Three	O. H. metal	Castings	10,000
Sormowo Steel Works	Sormowo	.....	3½	Basic	Single	O. H. metal	Castings, war materia	10,000
TOTAL IN RUSSIA: Operating 3; Yearly capacity 30,000 tons								
SWEDEN								
Aktiebola get Elektriska Stal	Kortfors	.....	3½	Basic	Single	Cold scrap	Tool stee	3,000
Akt. Liungly Stalgjutery	.....	2½	.....	....	....	Cold scrap	Castings	3,000
TOTAL IN SWEDEN: Operating, 1; Building, 1; Yearly capacity, 6,000 tons								
CANADA								
Electric Steel & Metals	Welland, Ont.	.....	6	Basic	Three	Cold material	Steel castings	6,000
TOTAL IN CANADA: Operating, 1; Yearly capacity 6,000 tons								
UNITED STATES								
American Steel & Wire Company	Worcester, Mass.	.....	12	Basic	Three	Molten metal	Steel ingots	25,000
General Electric Company	Schenectady, N. Y.	.....	5	Basic	Three	Cold material	Steel castings	3,000
General Electric Company	Schenectady, N. Y.	.....	2½	Basic	Three	Cold material	Steel castings	1,500
General Electric Company	Schenectady, N. Y.	.....	1	Basic	Three	Cold material	Steel castings	500
Halcomb Steel Company	Syracuse, N. Y.	.....	4	Basic	Single	Molten metal	Steel ingots	5,500
Crucible Steel Company of America	Harrison, N. J.	.....	5	Basic	Three	Molten and cold meta	Steel ingots	5,000
Treadwell Engineering Company	Easton, Pa.	.....	2	Basic	Three	Cold material	Steel castings	1,700
Lebanon Steel Foundry	Lebanon, Pa.	1	.....	Basic	Three	Cold material	Steel castings	1,200
Latrobe Electric Steel Company	Latrobe, Pa.	.....	6	Basic	Three	Cold material	Steel castings	6,000
Firth Sterling Steel Company	Demmler, Pa.	3	.....	Basic	Three	Cold material	Steel castings	6,600
Firth Sterling Steel Company	Demmler, Pa.	.....	3	Basic	Three	Cold material	Steel castings	6,600
National Malleable Casting Company	Sharon, Pa.	.....	5	Basic	Three	Molten and cold metal	Steel castings	8,000
Ditto	Chicago, Ill.	.....	5	Basic	Three	Molten metal	Malleable castings	24,000
United Steel Company	Canton, Ohio	.....	6	Basic	Three	Molten and cold metal	Steel ingots	8,000
Electric Steel Company	Indianapolis, Ind.	3	.....	Basic	Three	Cold material	Steel castings	3,600
Buchanan Electric Steel Company	Buchanan, Mich.	.....	3	Basic	Three	Cold material	Steel castings	3,600
Illinois Steel Company	Chicago, Ill.	.....	15	Basic	Three	Molten metal	Steel ingots	30,000
Illinois Steel Company	Joliet, Ill.	.....	4	Basic	Three	Cold ferromanganese	Molten ferromanganese	6,000
TOTAL IN UNITED STATES: Operating, 15; Building, 3; Yearly capacity, 141,200 tons								
GRAND TOTAL IN THE WORLD: Operating, 56; Building, 19; Yearly capacity, 1,015,450 tons								

Table 2. Girod Furnaces in Operation or Under Construction January 1, 1915

Company	Location	Size of furnace in tons: Building	Size of furnace in tons: Operating	Basic or acid	Current phase	Charge	Material produced	Capacity per year, tons
FRANCE								
Compagnie des Forges & Acieries Electriques, Paul Girod	Ugine, Savoy	.....	8 to 12	Basic	Three	Cold scrap	War materials	10,500
Ditto	Ugine, Savoy	.....	8 to 12	Basic	Three	Cold scrap	Special and tool	10,500
Ditto	Ugine, Savoy	.....	2½ to 3	Basic	Three	Cold scrap	Cast steel	3,150
Ditto	Ugine, Savoy	.....	2½ to 3	Basic	Three	Cold scrap	Cast steel	3,150
Ditto	Ugine, Savoy	.....	1½	Basic	Three	Cold scrap	Cast steel	1,575
Ditto	Ugine, Savoy	.....	20 to 25	Basic	Three	Cold scrap	Cast steel	20,000
Marrel Freres	Rive de Gier	.....	5	Basic	Single	Cold scrap and hot metal	.....	.....
TOTAL IN FRANCE: Operating, 7; Yearly capacity, 48,875 tons								

Table 2. Girod Furnaces in Operation or Under Construction January 1, 1915—Concluded

Company	Location	Size of furnace in tons: Building	Size of furnace in tons: Operating	Basic or acid	Current phase	Charge	Material produced	Capacity per year, tons
ENGLAND								
Rubery, Owen and Company	Darlaston, So. Staf.	3		Basic	Three			3,150
TOTAL IN ENGLAND: Building, 1; Yearly capacity, 3,150 tons								
GERMANY								
Stahlwerk Becker A. G	Krefeld-Willich		3	Basic	Single	Cold scrap and hot metal	Tool	3,150
Gutehoffnungshuette A. V	Oberhausen		3	Basic	Single	Hot steel	Various	9,000
Friederich Krupp A. G	Essen Ruhr		12	Basic	Three	Cold scrap	War material	12,600
Friederich Krupp A. G	Rheinhausen	3		Basic	Three	Ferromanganese	Molten Fe-Mn	
Oberschlesische Eisen Industrie A. G	Gleiwitz		8	Basic	Three	Cold scrap and hot steel	Fine steels	8,400
A. Stotz and Company	Stuttgart		1	Basic	Single	Cold scrap	Castings	
TOTAL IN GERMANY: Operating, 5; Building, 1; Yearly capacity, 33,150 tons								
AUSTRIA								
Steirische Gusstahlworke	Judenburg, Styria		2	Basic	Single	Cold scrap	Tool stee	2,100
Tornitzer Stahl & Eischworke-von-Schoeller	Ternitz, Sudbahn		5	Basic	Single	Cold scrap	Fine steels	5,250
TOTAL IN AUSTRIA: Operating, 2; Yearly Capacity, 7,350 tons								
HUNGARY								
Diosgyorer Kal. Eisen Stahlwerke	Diosgyorer		2	Basic	Single	Cold scrap	Projectiles, castings, fine stee	2,100
TOTAL IN HUNGARY: Operating, 1; Yearly capacity, 2,100 tons								
SWITZERLAND								
Oehler and Company	Aaru		2	Basic	Single	Cold scrap	Castings	2,100
Oehler and Company	Aaru	2		Basic	Single	Cold scrap	Castings	2,100
TOTAL IN SWITZERLAND: Operating, 1; Building, 1; Yearly capacity, 4,200 tons								
ITALY								
Gio. Ansaldo and Company	Genoa	4		Basic	Three	Cold scrap	Projectiles and armor plate	4,200
TOTAL IN ITALY: Building, 1; Yearly capacity, 4,200 tons.								
RUSSIA								
Putiloff Works	Petrograd	6		Basic	Three	Hot steel	War material	18,000
TOTAL IN RUSSIA: Building, 1; Yearly capacity, 18,000 tons								
BELGIUM								
Societe John Cockerill	Seraing		3	Basic	Single	Basic-Bessemer	Spring and tool steel	9,000
TOTAL IN BELGIUM: Operating, 1; Yearly capacity, 9,000 tons								
UNITED STATES								
Simonds Mfg. Company	Lockport, N. Y.		½		Single	Cold scrap	Fine steels	525
Bethlehem Steel Company	So. Bethlehem, Pa.	10						10,500
Bethlehem Steel Company	So. Bethlehem, Pa.	10						10,500
Bethlehem Steel Company	So. Bethlehem, Pa.	2						2,100
Washington Iron Works	Seattle, Wash.		3					2,100
Electric Steel Foundry	Portland, Ore.		1					1,050
TOTAL IN THE UNITED STATES: Operating, 3; Building, 3; Yearly capacity, 26,775 tons								
GRAND TOTAL IN THE WORLD: Operating, 20; Building, 8; Yearly capacity, 156,800 tons								

Table 4. Miscellaneous Electric Furnaces, Other than Heroult, Girod or Induction, Building or Operating in Europe, as Shown by Literature on the Subject

Type	No.
Stassano	15
Keller	6
Chapelet	5
Elektrometal	4
Grönwall	2
Niorth	1
Nathusius	2
Stobie (Building)	4
Anderson	4
Soderberg (Building)	1
Rennerfeldt	18
TOTAL IN EUROPE	62

Table 6 gives a recapitulation of the information given in Tables 1 to 5, showing the distribution of the various types of furnaces by countries as well as the total of each type in each country. In the last two columns are given the totals for July 1, 1913, and March, 1910, based on the tables referred to as published by *The Iron Age* in those years.

From these tables it is readily seen that the Heroult furnace leads all types in number of installations, with 75 in the world, the induction furnaces as a class coming next with a total of 36. Ranking second, in number of installations, is the Girod with 28 in the world.

Of the total of the 213 furnaces in the world, active or building January 1, 1915, 174 are of the arc type; 37 induction and 2 combined arc and induction. In July, 1913, of the 140 furnaces then in existence, the arc type claimed about 98; the induction, 40, with 2 of the combined arc and induction design.

The yearly capacity in tons of the two largest types of furnace is shown by the following table:

	United States and Canada, tons	Elsewhere in the world, tons	Total yearly capacity, tons
Heroult furnace	147,200	868,250	1,015,450
Girod furnace	26,775	130,025	156,800

While the yearly capacity of the induction furnaces is not given, their tonnage capacity is. This figures out to be 30 furnaces of 125.8 metric tons capacity outside of the United States and Canada which are credited with 6 furnaces having a tonnage capacity of 46 tons.

Table 3. Induction Furnaces in Operation or Course of Construction, January 1, 1915

Country	Firm	SIZE OF FURNACE, METRIC TONS: In course of construction	SIZE OF FURNACE, METRIC TONS: In operation	Type	Current (phase)	Charge
United States	Deere & Co., Moline, Ill.	.....	1.8	Kjellin	Single	Cold
United States	General Electric Company, Pittsfield, Mass.	.....	.2	Kjellin	Single	Cold
United States	Eastern Metals Corporation, Bayonne, N. J.	.....	2.0	Grondall-Siemens-Frick	Single (Brass)	Cold (Idle)
United States	American Iron & Steel Mfg. Co., Lebanon, Pa.	20	.....	Grondall-Siemens-Frick	Single	Liquid O. H.
United States	American Iron & Steel Mfg. Co., Lebanon, Pa.	20	.....	Grondall-Siemens-Frick	Single	Liquid O. H.
United States	Crucible Steel Castings Company, Lansdowne, Pa.	.....	2.0	Roechling-Rodenhauser	Single	Cold
England	Jessop & Sons	.....	1.8	Kjellin	Single	Cold
Germany and Luxembourg	Bergische Stahlindustrie, Remscheid	.....	5.0	Roechling-Rodenhauser	Single	Liquid O. H.
Germany and Luxembourg	Vereinigte Huettenwerke Burbach-Eich-Dudelingen, Dommeldingen	.....	3.5	Roechling-Rodenhauser	Single	Liquid O. H.
Germany and Luxembourg	Ditto	.....	3.5	Roechling-Rodenhauser	Single	Liquid, O. H.
Germany and Luxembourg	Ditto	.....	3.5	Roechling-Rodenhauser	Single	Liquid O. H.
Germany and Luxembourg	Stahlwerk Becker, Krefeld Willich	.....	2.0	Roechling-Rodenhauser	Single	Cold and liquid
Germany and Luxembourg	Fr. Krupp A. G., Essen a. Ruhr	.....	10.0	Frick	Single	Cold
Germany and Luxembourg	Fr. Krupp A. G., Essen a. Ruhr	.....	12.0	Frick	Single	Cold
Germany and Luxembourg	Oberschlesische Eisenindustrie A. G. Gleiwitz	.....	1.5	Kjellin	Single	Cold
Germany and Luxembourg	Peiner Walzwerk, Peine	.....	4.	Roechling-Rodenhauser	Three	Melting ferromanganese
Germany and Luxembourg	Roechlingsche Eisen & Stahlwerke, Voelklingen	.....	12.	Roechling-Rodenhauser	Single	Liquid basic Bessemer
Germany and Luxembourg	Roechlingsche Eisen & Stahlwerke, Voelklingen	12	.....	Roechling-Rodenhauser	Single	Liquid basic Bessemer
Germany and Luxembourg	Roechlingsche Eisen & Stahlwerke, Voelklingen-	.....	1.5	Roechling-Rodenhauser	Three	Liquid basic Bessemer
Germany and Luxembourg	Roechlingsche Eisen & Stahlwerke, Voelklingen	.....	4.0	Roechling-Rodenhauser	Three	Melting ferromanganese
Germany and Luxembourg	Aachener Huettenverein, Rothe Erde	.....	4.5	Roechling-Rodenhauser	Three	Melting ferromanganese
Germany and Luxembourg	Eichen & Company, Hagen	.....	3.0.	Roechling-Rodenhauser	Three	Liquid O. H.
Germany and Luxembourg	Rheinische Stahlwerke, Duisburg-Meiderich	1.5	.....	Roechling-Rodenhauser	Three	Melting ferromanganese
Austria	Braun's Soehne, Voecklabruck	.....	.4	Kjellin	Single	Cold
Austria	Poldihutte, Kladno	.....	4.5	Kjellin	Single	Liquid O. H.
Austria	Poldihutte, Kladno	13.0	.....	Grondall-Siemens-Frick	Single	Liquid O. H.
France	Acieries de la Marine et d'Homecourt, St. Chamond	.....	3.0	Roechling-Rodenhauser	Three	Cold
France	Chatillon Commentry & Neuves, Maisons-Montlucon	.....	1.5	Montlucon	Single	Liquid O. H.
Italy	Alti Forni Gregorini, Lovere	.....	1.6	Kjellin	Single	Cold and liquid
Italy	Ferrilre Pilmonteri, Turin	3.0	.....	Roechling-Rodenhauser	Three	Liquid O. H.
Russia	Kronwerke, Slatoust	1.0	.....	Roechling-Rodenhauser	Three	Cold
Sweden	Domnarfvet Iron Works, Gysinge	.....	1.5	Kjellin	Single	Cold
Norway	Stavanger Electro Steel Works, Stavanger	.....	4.0	Roechling-Rodenhauser	Single	Liquid O. H.
Spain	Urigoitia e Hija, Araya	.....	1.5	Kjellin	Single	Cold
Japan	Imperial Japanese Steel Works, Wakamatsu	3.0	.....	Roechling-Rodenhauser	Three	Liquid O. H.
Mexico	Ricardo Honey	.....	2.5	Roechling-Rodenhauser	Three	Liquid O. H.
TOTAL: Operating, 28; building, 8.						

Table 5. Electric Furnaces, Other than Heroult, Girod and Induction, in the United States and Canada

Company	Location	Type	Size, Tons	Acid or basic	Phase	Charge	Product	Daily Capacity per 24 hrs., tons
Moffat Irving Steel Works, Lt'd	Toronto, Ont.	.....	1.1	Basic	Three	Cold scrap	Castings	..
Ludlum Steel and Spring Company	Watervliet, N. Y.	.....	2.1	Basic	.....	Cold scrap	Tool steel	..
Niagara Electric Steel Corporation	Buffalo, N. Y.	Hering	.5	.....	.....	.....	.....	..
Firth Sterling Steel Company	Washington, D. C.	Stassano	1.4	Basic	Three	Cold scrap	Ordnance	..
Warren Steel Casting Company	St. Louis, Mo.	Stassano	1	Basic	Three	Cold scrap	Castings	..
Warman Steel Casting Company	Redondo Beach, Cal.	Stassano	1	Basic	Three	Cold scrap	Castings	..
Hess Steel Casting Company	Bridgeton, N. J.	Stassano	1	Basic	Three	Cold scrap	Castings	..
Chicago Electric Casting Company	Chicago, Ill.	Snyder	1.4	Basic	Single	Cold scrap	Castings	12
Erie Malleable Iron Company	Erie, Pa.	Snyder	1.4	Acid	Single	Cold scrap	Castings	20
Crucible Steel Casting Company	Milwaukee, Wis.	Snyder	1	Acid	Single	Cold scrap	Castings	12
Otis Elevator Company	Buffalo, N. Y.	Snyder	2	Acid	Single	Cold scrap	Castings	30
Otis Elevator Company	Buffalo, N. Y.	Snyder	3	.....	Single	.....	Castings	30
TOTAL: Operating, 10; Building, 2.								

Table 6. Types of Electric Furnaces by Countries in 1915, with Totals for 1913 and 1910

Countries	Heroult	Girod	Induction	Stassano	Keller	Chaplet	Electrometals	Hiorth	Nathusius	Rennerfeldt	Grönwall	Special	Total Jan. 1, 1915	Total July 1, 1913	Total March, 1910
Germany and Luxemburg	19	6	16	2	1	.....	.....	.....	2	.....	.....	.....	46	34	30
Austria-Hungary	10	3	3	2	.....	.....	.....	.....	.....	.....	.....	.....	18	10	10
Switzerland	1	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	2	2
Italy	4	1	2	5	5	5	.....	.....	.....	.....	.....	.....	22	20	12
France	8	7	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	17	13	23
England	7	1	1	4	.....	.....	.....	.....	.....	3	.....	.....	16	16	7
Belgium	2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	3	3
Russia	3	1	1	2	.....	.....	.....	.....	.....	2	.....	.....	9	4	2
Sweden	2	.....	1	.....	.....	.....	2	.....	.....	13	.....	.....	18	6	5
Norway	.....	.....	1	.....	.....	.....	1	.....	.....	.....	.....	.....	2	3	
Spain	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	
Japan	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	1	...
Mexico	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	4	3
Brazil	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	.....
Location not given	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	2	9	12	.....	.....
Total outside of the United States and Canada	56	22	30	15	6	5	4	1	2	18	2	9 =	170	118	101
United States	18	6	6	4	.....	.....	.....	.....	.....	.....	.....	7*=	41	19	10
Canada	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1 =	2	3	3
Total in the United States and Canada	19	6	6	4	.....	.....	.....	.....	.....	.....	.....	8 =	43	22	13
Grand total in the world	75	28	36	19	6	5	4	1	2	18	2	17=	213	140	114

*Includes 5 Snyder furnaces.

DEVELOPMENT IN THE UNITED STATES

Development in the United States and Canada in the last two years has been distinguished by the entrance into the field of three types of furnaces not operating in Europe: The Snyder, the Hering and the special furnace of the Moffat-Irving Steel Works, Ltd., Toronto, Ontario, in which castings are made direct from the ore. This furnace was described in *The Iron Age*, January 8, and October 15, 1914. In the same period the installations of the Heroult furnace have increased from 7 in 1913 to 19 at present.

What is regarded as the largest electric furnace plant in this country, making steel, is the one nearing completion at the works of the American Iron & Steel Mfg. Company, Lebanon, Pa. This installation consists of two 20-ton induction furnaces for refining steel from the company's new open-hearth department.

Mention should be made of the excellent achievements of electric furnaces making pig iron direct from iron ore, especially the one at Heroult, Cal., and the important ones in Sweden. Nor should a review of this important subject omit to state that the Heroult and other types are used in this country to melt alloys and metals for the production of special alloys and steels.

United States Stands Second

Comparing the United States with the rest of the world it is interesting to note that the progress has been rapid. In the United States in particular the increase has been decided, growing from a total of 10 in 1910 to 19 in 1913 or nearly 100 per cent., and from 19 in 1913 to 41 on January 1, 1915, or over 100 per cent. Of special importance is the fact that while Germany has been and is still in the lead as to the number of furnaces in operation or building (46), the United States is a close second with 41. Only two years ago the comparison was decidedly to the disadvantage of this country, standing 34 to 19.

Based on these data and on developments growing out of the war the future holds out a strong hope that this country will soon lead the world in the number of electric furnaces making steel, if not also in their yearly capacity.

Industrial Growth in the Cleveland District

A Number of New Metal-Working Plants Erected and Many Extensions Built in Northern Ohio in 1914

A good record in industrial expansion was made in Cleveland and other northern Ohio cities in 1914 in spite of the generally unsatisfactory business conditions throughout the entire year. Many factory owners in metal-working lines enlarged their plants, some because they had faith in the future rather than being compelled by immediate demand to provide additional facilities, and others because their business had continued to grow so that greater factory capacity was necessary. A few new industries were established requiring good sized quarters, and in some cases entirely new plants were built by existing companies to provide larger output and improved manufacturing facilities, but plant building work was more generally confined to enlarging plants already in operation. With one exception, the automobile manufacturers in the Ohio territory did little in the way of plant extensions, but a number of makers of automobile parts and accessories built factory additions.

Much important work in steel plant construction was done, this being referred to more fully in the resumé elsewhere of the country's iron and steel work construction for 1914. This included the work on the steel plant of Corrigan, McKinney & Co., started late in 1913, which is nearing completion; the placing of contracts by this firm for two blast furnaces; the starting up of the new light plate and sheet mills of the Otis Steel Company; the erection of an open-hearth plant by the Central Steel Company, Massillon; the building of sheet mills by the Western Reserve Steel Company, Warren; the doubling of the capacity of the sheet mill plant of the Trumbull Steel Company, Warren, and the rebuilding and enlarging of a sheet mill plant in Mansfield.

Among the most important building projects carried out in Cleveland and vicinity in 1914 are the following:

The Parish & Bingham Company, maker of automobile frames and other pressed steel stampings, has recently completed a large plant on a new site which will greatly increase its former capacity. The plant includes a main building, 100 x 900 ft., and a separate office building.

The Cleveland Metal Products Company has nearly completed extensive additions to its plant in order to add to its present line of products, which comprise aluminum sheets, castings and cooking utensils. The additions include an extension, 100 x 266 ft, for the manufacture of cooking utensils; a castings building, 57 x 83 ft., and a rolling mill building, 82 x 100 ft.

The National Lamp Works of the General Electric Company completed the last unit of an extensive group of factory buildings. These new buildings include a sheet metal-working factory for the manufacture of light fixtures, a glass making plant and a power plant.

The Enamel Products Company built a new one-story plant, 80 x 200 ft., on a new site, having outgrown its former quarters.

The K. W. Ignition Company, maker of automobile accessories, enlarged its plant by an addition of 83 x 127 ft.

The Ferry Cap & Set Screw Company increased its plant capacity by the erection of a three-story addition, 40 x 176 ft.

The Allyn-Ryan Foundry Company added considerable to the capacity of its foundry, to which it built an extension, 112 x 120 ft.

The Osborn Mfg. Company, maker of molding machines, brushes and various foundry supplies, added a three-story building to its plant.

The Electric Welding Products Company enlarged its plant by the erection of a one-story addition, 45 x 123 ft.

The Vlcheck Tool Company, maker of mechanics' hand tools, enlarged its plant by the erection of a two-story addition, 80 x 150 ft.

The Madison Foundry Company built a new plant to take the place of one that was destroyed by fire.

The Peters Machine & Mfg. Company, maker of automobile parts, erected a new one-story plant, 80 x 209 ft.

The Cyclone Woven Wire Fence Company made considerable extensions to its plant capacity.

The Cleveland-Akron Bag Company erected a large seven-story steel factory building and power plant.

The Yuster Axle Company, a new concern, established a plant for the manufacture of automobile axles.

The Wallis Tractor Company equipped and placed in operation a plant for the manufacture of farm tractors.

The Cleveland Casting Pattern Company and the Wood & Spencer Company, an allied concern, engaged in building special machinery, completed and moved into a new four-story plant, 60 x 100 ft.

The Cleveland Welding & Mfg. Company enlarged its plant by the erection of an addition, 75 x 176 ft.

The Willard Storage Battery Company has nearly completed a new plant, 135 x 200 ft.

The Hunt & Dorman Mfg. Company, maker of sheet metal stampings and dies, has commenced the erection of a new plant providing 22,000 sq. ft. of floor space.

The Ford Motor Company has under way the erection of a large four-story service station.

A new plant has been erected by the Hendrickson Machine Company.

The William Bingham Company, wholesale hardware dealer and jobber in iron and steel, has under erection an eight-story warehouse, 200 x 835 ft.

Plant extensions of considerable size were made by the Horsburgh & Scott Company and the P. A. Geier Company.

The Upson Nut Company has had under construction the second section of a hot forge shop at its bolt and nut works which is practically completed, making the shop 125 x 630 ft.

The Bourne-Fuller Company has built a large addition to its iron and steel warehouse.

In Alliance a new plant for fabricating structural steel was built by the Alliance Structural Company, a new company. The building is 121 x 296 ft. Provisions are made for an addition nearly as large as the present plant.

Industries in Canton experienced considerable growth. A new plant was built in that city by the Monarch Metal Mfg. Company for the manufacture of metal doors, sash and other sheet metal building material. The plant occupies a site 80 x 460 ft. An addition of 50 x 110 ft. was made to the plant of the Timken Roller Bearing Company. The Union Metal Mfg. Company enlarged its plant by a one and two-story addition, 70 x 250 ft.

In Warren the Chicago-Cleveland Car Roofing Company erected a new plant, 140 x 300 ft., for the manufacture of sheet metal roofing material for cars and the Trumbull Steel Company enlarged its plant, doubling its sheet-making capacity.

In Niles the Niles Forge & Mfg. Company is taking steps to enlarge its plant by the erection of two new factory buildings, one a structural steel department, 50 x 200 ft., and the other a forge shop, 40 x 60 ft. The Ohio Galvanizing & Mfg. Company built a large addition to its plant.

The Willys-Overland Company, Toledo, automobile builder, completed several plant extensions early in the year, and late in the year placed contracts for further additions that include a two-story and basement assembling building, 200 x 1000 ft, and an addition, 200 x 200 ft., to its body manufacturing plant. The Toledo Pipe Threading Machine Company acquired a new site and erected a fine new manufacturing plant into which it recently moved, about doubling its former capacity.

Factory construction in Massillon includes a large plant built by the American Stamping & Enameling Company and a new plant built by the Massillon Aluminum Company, the latter being a three-story and basement building, 42 x 240 ft.

In Akron the Adamson Machine Company has enlarged its foundry by the erection of an addition, 80 x 100 ft., and the Firestone Tire & Rubber Company has built two large five-story factory buildings, adding 95,000 sq. ft. of floor space.

In Elyria the Columbia Steel Company has enlarged its plant by an addition, 53 x 103 ft., and the Superior Metal Products Company has made a plant extension, 66 x 165 ft.

The American Malleable Castings Company, Marion, recently completed factory additions including one building, 130 x 175 ft.; another, 60 x 65 ft., and an office building.

In Lorain the Thew Automatic Shovel Company early in the year completed two additions to its plant.

In Mt. Gilead the Hydraulic Press Mfg. Company added a brass foundry, 30 x 90 ft., and an erecting shop, 80 x 120 ft.

The Electrical Alloy Company, manufacturer of resistance materials, Morristown, N. J., has opened a branch office at 180 North Dearborn street, Chicago, Ill., in charge of L. L. Fleig & Co., who have been appointed Western representatives.

Oxygen Content of Coal Diminishes Its Coking Power

In a paper by G. Stanley Cooper, Sheffield, England, prepared for the Iron and Steel Institute, entitled "The By-Product Coking Industry and Its Relation to the Manufacture of Iron and Steel," the author states that as the oxygen content of the coal increases the coking power decreases. The portion of the paper treating of this phase of the subject is as follows:

Many investigations have been carried out with the object of determining what constitutes the coking property of coals, and what are the reasons for the varying behavior of different classes of coal on carbonization. Finality in the matter has by no means been reached, but it is possible, as a result of collected experiences, to lay down certain general rules concerning the relationship between the composition of coal and its coking capacity. Perhaps the most important of these is that as the oxygen content increases the coking power decreases, and it is generally assumed that a coal with more than 8 per cent. of oxygen on an ash-and-moisture-free basis is a non-coking coal, or at any rate a poor coking one. This view is further borne out by consideration of the results obtained in the distillation of various classes of coal. The oxygen in the original coal is distributed on distillation in the form of H_2O (ammoniacal liquor), CO_2 and CO. The following results were obtained by the author with different classes of coal, and it will be seen that, speaking generally, the figures for H_2O, CO_2, and CO are a good guide as to the coking property of the coal. The tests were all performed with dry coal under the same conditions.

Coal	Coke, per cent.	H_2O, per cent.	CO_2, per cent.	CO, per cent.	Remarks
Cumberland	69.8	5.34	0.94	6.0	Good coke
Durham	76.5	4.11	1.02	4.6	Good coke
Warwick	62.0	12.98	3.6	10.6	Poor coke
Monmouth	80.0	3.37	0.51	3.2	Good coke
Staffs	71.0	7.53	1.08	4.9	Good coke
Yorks	70.0	6.66	1.28	7.8	Good coke
Lancashire	70.0	6.80	1.48	5.2	Good coke
Lanark	65.0	8.09	2.45	10.7	Fair coke
Fife	68.0	9.12	1.99	7.6	Good coke
Northumberland	67.0	8.55	2.46	7.8	Fair coke
Forest of Dean	68.0	6.73	1.58	7.5	Fair coke
Brown coal, Australia	48.0	12.78	8.22	23.0	Poor coke
Leicester	63.0	10.52	2.74	12.4	Poor coke
Lancashire cannel	63.0	6.19	0.56	5.6	Poor coke

In a large number of tests carried out by the author the general conclusion arrived at is that if the yield of H_2O from the dry coal on distillation is more than 7 or 8 per cent., the coke produced is of an inferior character. There are a few exceptions to this generalization, but on the whole it is quite a satisfactory guide. The majority of Scotch coals behave in a very peculiar way. If the coal be ground up and carbonized immediately a good coke is obtained. If, however, it be allowed to be exposed to the air for any length of time, and particularly if it be in a finely divided and moist condition, its coking power deteriorates very considerably. Indeed the author has found that a coal which produces a good coke when treated immediately after grinding will scarcely cohere on being carbonized after a day or two of exposure, the reason probably being that the coals absorb oxygen from the air on exposure, and this view is borne out by the fact that the yield of liquor on distillation is greater after exposure than before. Consequently it is important with such coals to take precautions against the effect of atmospheric exposure, and to carbonize the coal as soon as possible after it comes from the mine.

New Sheet Mill Started

The Western Reserve Steel Company, Warren, Ohio, C. G. Thomas, president, started up its new sheet mill plant January 4. There are five hot mills and a jobbing mill. Three of these are in operation and the other three, together with the galvanizing department, will be started up in about two weeks. The company's output will be chiefly metal lathing.

New Iron and Steel Works Construction

(*Continued from Page 32*)

ditional four-hole pit furnace was also installed at the No. 4 mill. An extension at the south end of the No. 6 mill will provide storage for billets.

An economizer plant has been installed at No. 3 boiler house, in connection with 16 250-hp. Cahall boilers. Two steam turbine-driven condenser pumps were installed in power house No. 1, a condenser pump at No. 3 mill and two steam turbine-driven condenser pumps at No. 4 mill. The new electrical repair shop was completed and placed in operation. An impregnating apparatus was provided in the electrical repair shop for impregnating armature and field coils. A second heavy shear was installed at the scrap yard.

Central Iron & Steel Company

Among improvements made by the receivers of the Central Iron & Steel Company, Harrisburg, Pa., were the following additions to equipment: Two pumping plants to supply the entire works with river water direct, replacing purchased water from the city; a straightening machine for the 42-in. universal mill; a new motor-driven flanging machine of much greater capacity; replacing a number of small steam engines by motors; a new charging crane for the open hearth; grate equipment on a battery of 12 boilers for burning low grade fuel, resulting in much more economical operation. Several important changes in detail were made in the open-hearth furnace construction and reversing valves, all tending toward an improved product and greater tonnage. The lighting system of the entire works was changed from arc to tungsten.

United Steel Company

The United Steel Company, Canton, Ohio, built and put in operation in the past year a 9-in. bar mill and a 6-ton Heroult furnace. It has placed a contract with the Mackintosh-Hemphill Company for a large universal mill, which it expects to install early in 1915. It will be a 34-in. mill with a capacity for rolling from 8 in. in width to 48 in. It will probably be in operation by March 1. This mill was the last designed by the late Joseph Fawell.

Gulf States Steel Company

The Gulf States Steel Company in 1914 installed at Alabama City, Ala., three 750-kw. motor generator sets with switchboard and other accessories, for the purpose of changing from steam generating electrical units to hydro-electric power; also a 20-in., three-stand, three-high merchant bar mill for making merchant bars, tie plates, etc. In the wire department there were added two field fence machines of the Denning type for making field fence, also six bale tie machines, and one F. X. Hooper printing machine for printing barb wire spools. Throughout the entire year the company has continued driving its slope at Shannon, Ala., in Shades Valley, for the purpose of deep iron ore mining and expects to reach ore by another year.

Wisconsin Steel Company

The enlargement and reconstruction of No. 1 blast furnace at South Chicago were completed at a cost of $120,000. At the steel works a new cupola was built and miscellaneous improvements were made, the whole amounting to $88,000.

Central Steel Company

This company, which is identified with the Massillon Rolling Mill Company, Massillon, Ohio, started on the building of open-hearth furnaces at Massillon in April, 1914, and expects to be making steel in April, 1915. There will be three 50-ton furnaces, three 4-hole soaking pits, a 34-in. reversing blooming mill, two 3-high 28-in. sheet bar mills and a bull-head for the finishing pass. All will be electrically driven. More detailed description, with illustrations, appears on other pages.

West Penn Steel Company

At the Brackenridge, Pa., plant of the West Penn Steel Company an additional 80-ton open-hearth furnace was completed in the past year. Other installations and extensions include a scrap yard steel frame 360 ft. long, a 15-ton and a 20-ton traveling crane, 216-ft. extension to the open-hearth building, soaking pit extension, and various additions to equipment, including charging machine, jaw crusher, 150-ton track scale, 100-ton open-hearth ladle, annealing furnace charger, roll polisher, stokers, etc.

Inland Steel Company

The principal new construction at the Indiana Harbor plant of the Inland Steel Company was the completion last year of 20 additional coke ovens, making 86 in all. The company has no extensions under construction, as business conditions have not justified planning of improvements or anything new.

Youngstown Iron & Steel Company

The Youngstown Iron & Steel Company began work August 1 on the construction of an open-hearth steel plant at Lowellville, Ohio, four miles east of its present plant at Haselton, Youngstown. There will be three 75-ton furnaces, and it is expected work will be completed in May. The steel will be rolled on a two-high rolling mill electrically driven and finished on a dual two-high sheet bar mill, also electrically driven. The company has contracted with the Ohio Iron & Steel Company, Lowellville, for its requirements of molten pig iron, the latter company's blast furnace being about ¾ mile east of the steel plant.

Pennsylvania Steel Company

The principal new construction and improvement work completed in 1914 at the Steelton, Pa., plant of the Pennsylvania Steel Company, was the following: One 75-ton stationary open-hearth furnace; two 100-ton tilting open-hearth furnaces and two Bessemer converters, to be used in duplexing; new general office building; one 2000-ton forging press; coal washing plant with daily capacity of 2000 tons to be used in connection with coke oven plant. Work in progress at Steelton is as follows:

New blooming, structural and girder rail mill, begun in 1914 and about 66 per cent. completed at the end of the year.

New 500-ton blast furnace with ore-handling bridge, begun in 1914 and about 20 per cent. completed at the end of the year.

Eye bar plant, construction begun in 1914 and about 50 per cent. completed at the end of the year.

Maryland Steel Company

In the past year the Maryland Steel Company completed at Sparrows Point, Md., its new coke oven plant consisting of 120 Koppers by-product ovens. The reconstruction of the fourth blast furnace was completed, the new dimensions being 17-ft. hearth, 22-ft. bosh and 85 ft. in hight, giving it a capacity of 500 tons a day. In the rolling mills there were added new ingot stripper, soaking pit cranes, manipulators, etc.

Upson Nut Company

No steel plant changes were made by the Upson Nut Company, Cleveland, Ohio, but in the adjoining bolt and nut works a new hot forge shop was practically completed. The building is 180 x 660 ft., of sawtooth roof construction, and is laid out in three 60-ft. bays, each served with overhead cranes and monorail system.

Other Steel Works Additions

The N. & G. Taylor Company, Philadelphia, Pa., awarded the contract in the summer of 1914 for a 100-ft. addition to the open-hearth steel department of its works at Cumberland, Md., to provide for another 25-ton basic open-hearth furnace. The building is of structural steel sheathed with corrugated galvanized sheets, and the equipment includes a 40-ton overhead traveling crane with a 7½-ton auxiliary hoist. For the power plant a 24 x 24-in. piston valve heavy duty Harrisburg engine was contracted for, to be directly connected to a Crocker-Wheeler 300-kw. generator.

The Portsmouth Steel Company, Portsmouth, Ohio, has equipped a sheet bar mill in the past year and has under way a finishing department that will increase its sheet galvanizing facilities.

The American Iron & Steel Mfg. Company, Lebanon, Pa., has still under construction four 50-ton open-hearth furnaces and two 20-ton Frick induction furnaces, plans for the former having been announced in 1913.

The Washington Steel & Ordnance Company, Washington, D. C., built an extension to its alloy steel department, 80 x 140 ft., a machine shop addition, 48 x 80 ft., and a storage department, 48 x 240 ft. All the buildings are of brick and steel. A 500,000-gal. steel storage tank for oil has been provided.

The Eagan-Rogers Steel & Iron Company, Crum Lynne, Pa., has added a complete sand blasting equipment in its steel foundry. For the very light work there is a tumbling barrel with nozzles at both ends, the sand dropping into a concrete pit, from which it is taken by conveyors to screens, falling by gravity to the sand blast machines, where it is used over again. For the larger castings a room is provided with a concrete pit, sand conveyor, dust fans and other apparatus. Two large Ingersoll-Rand air compressors were installed. Two one-ton jib cranes have been added, equipped with an electric hoist.

The Ashland Steel Company, Ashland, Ky., which made extensive additions in 1913, did no new work in 1914. An additional 10-ton electric crane was installed.

The Atlanta Steel Company installed a new motor generator system last year at a cost of $7500.

The American Steel Foundries added a 1000-kw. Westinghouse low-pressure steam turbine at its steel foundry at Granite City, Ill.

The John A. Roebling's Sons Company, Trenton, N. J., has brought near to completion its wire mill No. 3, at the Roebling, N. J., works, this being constructed for future rather than present requirements. In some departments special machines have been added.

The LaBelle Iron Works, Steubenville, Ohio, built a new foundry, 60 x 80 ft., and made a general rearrangement of the stockhouse and trestle equipment in its open-hearth department. At the Wheeling plant new shipping buildings were provided and a new crane.

Considerable new construction has been under way in the past year at the works of the Follansbee Bros. Company at Follansbee, W. Va. It includes three hot sheet mills, two cold sheet mills, six pair heating furnaces, three sheet heating furnaces, a 1000-hp. motor, three double sheet annealing furnaces and three galvanizing pots; also a complete equipment of roofing machinery. A new brick building, 60 x 200 ft., was erected with a lean-to 40 x 200 ft., for the galvanizing shop. A new brick warehouse building is two stories, 65 x 200 ft. The additional power equipment consists of a 1500-kw. turbine. Stokers and coal handling machinery and storage equipment were provided at the boiler plant.

THE STEEL CORPORATION

As has been well known, the quarterly statements of the United States Steel Corporation have shown financial results which absolutely precluded new construction appropriations, deficits being the rule. Thus all extension work has been halted, the building of a Canadian plant being indefinitely postponed. The data given below concerning improvements made at Steel Corporation plants in 1914 are the most meager in many years, representing almost entirely the completion of work that was under way one year ago.

Indiana Steel Company

The 36-in. slabbing mill which was under construction at the beginning of 1914 was completed last year and has been in successful operation. The installation of waste-heat boilers of the Rust type has been completed for 28 open-hearth furnaces. Tar burning apparatus which was installed at two open-hearth furnaces at Gary has been in continuous operation.

Illinois Steel Company

The remodeling of the rail mill at South Chicago to equip it for turning out sheet bars and billets was completed and the new equipment has been in operation. The addition of a finishing end for sheet bars and of handling arrangements for sheet bars and billets made by it possible to roll the latter simultaneously with rails. Four new stoves have been built at the No. 2 Joliet blast furnace. At the North works at Chicago the company has replaced all its wooden structures—fabricating buildings and storage warehouses—with fireproof buildings.

At St. Paul, Minn., the Illinois Steel Company has completed in the past year an extensive warehouse and distributing plant.

Carnegie Steel Company

The reconstruction of the No. 2 and No. 3 blast furnaces at Clairton, Pa., on new lines was completed, their capacity being increased from 450 to 500 tons per day. At the Carrie furnaces No. 6 stack was rebuilt on new lines, and similar work on No. 7 is now under way.

At Duquesne steel works the 10-in. merchant bar mill which is electrically driven has been put in operation. At this plant 14 open-hearth furnaces have been changed for the use of producer gas. The installation of a new engine on the 28-in. roughing mill is under way.

At the opening of 1914 seven of the 14 new open-hearth furnaces at Edgar Thomson works were in operation. The others were completed in the past year. The new blooming mill at Edgar Thomson was completed and put in operation. The work on the new rail mill is not entirely finished. A new roll shop was built in the last year, and there is under way the installation of eight straightening presses for rails weighing upwards of 100 lb. per yard.

A new heat treating plant for locomotive driving axles has been put in operation at the Howard axle works and at the Schoen steel wheel works a 10,000-ton forging press was added.

At the Painter works, Pittsburgh, two 500-hp. motors were placed on the No. 6 and No. 8 mills and a contract has been let for motor equipment for Nos. 2 and 3 mills at this plant.

Two mixed-flow turbo-blowers have been installed in the Bessemer works of the New Castle, Pa., plant.

At the coke plant at Farrell, Pa., a benzol plant is under construction with a capacity of 800,000 gal. of benzol per year under average working conditions. It will have facilities for the extraction of the higher benzol products such as toluol, xyol and naphtha. Two new gas coolers and an ammonia still have been added at the by-product coke plant.

At the Ohio steel works, Youngstown, Ohio, a new metal yard has been provided, equipped with an electric traveling crane, and a plant has been built for the commercializing of blast furnace slag. A concrete pattern storage building has been completed.

At the Mingo Junction plant the improvements consist of a new engine on the continuous sheet bar and billet mill, new machine shop equipment and the erection of a modern pattern storage building.

At Boston, Mass., the New England warehouse of the Carnegie Steel Company is about finished.

American Steel & Wire Company

At the Cuyahoga plant in Cleveland the addition of buildings and equipment provided for increasing the output of cold rolled material have been practically completed. At Fairfield in the Birmingham, Ala., district the new rod and wire mills were put in operation in 1914.

Tennessee Coal, Iron & Railroad Company

An additional turbo-blower of the Ingersoll-Rand type has been installed at the blast furnace plant at Ensley, making three now in use at this group of furnaces. Work was begun on the construction of a plant for the production of phosphate fertilizer from the basic slag of the open-hearth furnaces.

National Tube Company

Extensive reconstruction and additions of machinery have been completed at the Pennsylvania Tube Works, Pittsburgh. At McKeesport, Pa., the remodeling of the main boiler plant has been under way.

Minnesota Steel Company

Work has been in progress on three additional open-hearth furnaces, making 10 in all, with an annual capacity of about 500,000 tons. The two blast furnaces and the 90 Koppers coke ovens are now nearly completed. Considerable equipment for the open-hearth plant is yet to be ordered. The site of this company's new plant and the town located near the works will be known as Morgan Park. It is in the city limits of Duluth, but in the extreme western part. Thus far 170 houses containing 350 apartments have been completed. They are of hollow concrete block construction and are in all respects modern.

ROLLING MILL WORK

The Trumbull Steel Company, Warren, Ohio, built 12 additional hot mills last year, making in all 24 mills, 12 of which are sheet mills and 12 tin mills. The company has also added to its finishing capacity, so that it now consists of eight galvanizing kettles and 24 tinning stacks, together with a large roofing and forming plant. The annual output now is 125,000 tons of sheets and tin plates. The plant contains 21 stands of cold rolls, which are electrically driven. The main mill building is 1200 ft. long and 256 ft. wide, containing three crane runways. The tinning department is 600 ft. long and 70 ft. wide, and the galvanizing and forming department, 800 ft. long and 163 ft. wide. The hot and cold mills and the squaring shears were furnished by the United Engineering & Foundry Company and the 34 x 68 x 60 horizontal tandem compound engine for driving the hot mills, by the William Tod Company, Youngstown, Ohio. The boilers are stoker fired and there is automatic ash and coal handling. The plant is equipped with 11 Morgan cranes and with Koppel electric transfer cars.

The St. Louis Screw Company has been building in the past year and will have ready for operation about March 1, 1915, a new bar mill for rolling both iron and steel. The plant consists of a 20-in., three-high, two-stand puddle mill with six heating furnaces; one 18-in. mill and one 9-in. mill. The mill will be exceptional in the use of pulverized coal for the heating furnaces and also in the use of a high-speed chain drive on the 18-in. mill. Motor units are to be used for driving the mills throughout. The plans of the company, which now operates a bolt and screw manufacturing plant, contemplate the erection of a new bolt and screw works adjoining the bar mill.

The Falls Hollow Stay Bolt Company, Cuyahoga Falls, Ohio, maker of round, hollow and solid staybolt iron and steel bars, made plans in 1914 for a rolling mill and muck mill and work will begin as soon as foundations can be laid in 1915. There will be an 18-in. muck mill, a 16-in. three-high Belgian train, a 12-in. three-high roughing and skelp mill, and two 10-in. finishing mills. The buildings will be of steel and the mills will be electrically driven.

The Mansfield Sheet & Tin Plate Company, Mansfield, Ohio, which took over the Richland Steel Company's plant in that city, expects to have its three sheet mills and black plate mills in operation this month.

The Reeves Mfg. Company, Canal Dover, Ohio, completed the following improvements in 1914: A warehouse building, 120 x 220 ft.; an addition to the sheet mill department, 120 x 200 ft., and an addition to the skelp mill department, 120 x 150 ft. An additional tin mill and an additional galvanizing pot were provided.

The Page Woven Wire Fence Company, Monessen, Pa., has added another weaving department for the manufacture of wire fencing, also a department for the manufacture of ornamental wire fencing and fence gates. The company has a total of about 80 fence looms. At the Adrian, Mich., plant it is continuing the manufacture of wrought iron ornamental fencing as well as gates, and has installed an extensive department for the manufacture of wind shields for automobiles.

The Sellers Mfg. Company, Chicago, manufacturer of tie plates and angle bars, has made some outlay in perfecting its new heating furnaces. A motor-driven portable shear has been added and two feed water heaters, one 1000-hp. and the other 1200 hp., of the Cookson cast iron type, made by the Bates Machine Company.

The Empire Rolling Mills Company, Cleveland, late in the year announced plans for the erection of sheet mills, but with the reservation that the work would not be started until the financial situation improved. The company is now going ahead with the work without further delay. The plant will include six finishing mills, two stands of cold rolls and a galvanizing department. Motor drive will be provided throughout and electricity will be purchased. The sheet mills will occupy a building 145 x 528 ft. adjoining the present rolling mill plant.

In the past six months the Massillon Rolling Mill Company, Massillon, Ohio, has built one additional sheet mill which makes the total number of hot mills 11. An addition to the plant of 180 ft., has been built and will be used for storage purposes in the finishing department.

BLAST FURNACE WORK

The Northern Iron Company, Port Henry, N. Y., has relined its Port Henry furnace, enlarged the stockhouse and put in new scales, the total expenditure being $43,000. The company's Standish, N. Y., furnace was re-

lined early in 1914, and considerable other repair work was done, all costing about $63,000.

The Alabama Company, Birmingham, Ala., relined its furnace No. 2 at Ironaton, Ala., and erected a new boiler and pumping plant and a new commissary building. At its Attalla mine two motor-driven centrifugal pumps were installed and the crusher changed from steam driven to electric driven. At its Brookwood coal mine a rock slope 600 ft. long was completed.

The Lake Superior Iron & Chemical Company, Detroit, Mich., Frank W. Blair, receiver, entirely rebuilt its charcoal blast furnace at Newberry, Mich. At Ashland, Wis., the furnace was relined and general repairs were made. The total expenditures were about $50,000.

Extensive improvements were made by the Empire Steel & Iron Company at its iron mine at Mount Hope, N. J., providing what is probably the most up-to-date mining equipment and crushing machinery in Eastern districts, and making possible an output of 20,000 tons a month of ore ready for the furnace, averaging close to 60 per cent. metallic iron. The Wellman-Seaver-Morgan Company furnished a double-drum geared electric hoist capable of handling a total load of 12,000 lb. at a speed of 1000 ft. per min. The drum is 60 in. diameter and 36 in. face. A 24-in. Robins belt conveyor was installed, 204 ft. center to center, with a capacity of 60 tons per hr. at a belt speed of 200 ft. per min. Three Westinghouse electric generators were added, one of 550 kw. and the others 35 kw. and 30 kw., also two 125-hp. hoist motors and four 75-hp. hoist motors. The building housing the above machinery is of reinforced concrete, made of Allentown Portland cement and the company's own ore tailings. A steel headframe was erected to replace one of wood, also steel ore bins. A new crusher house contains a 36 x 24-in. jaw crusher and a pan conveyor, motor driven. A quintuplex pump with a capacity of 600 gal. per min. against a maximum head of 540 ft. is operated by a 100-hp. Westinghouse motor. The addition of a 910-hp. Babcock & Wilcox boiler in two units gives total boiler capacity of 1500 hp. Three single-drum geared electric hoists were installed in different parts of the mine. The underground haulage is carried on over 2500 ft. by an electric trolley system with two Westinghouse Baldwin locomotives. A new separating mill was built by the Allis-Chalmers Company and a drying system to prepare the ore for separation before reaching the mill. Storage capacity of 50,000 tons of ore was built, equipped with a conveying system. At Oxford, N. J., the company is regularly mining about 10,000 tons of ore a month. Few improvements were necessary in 1914, the entire plant having been rebuilt prior to that year.

The Wickwire Steel Company, Buffalo, N. Y., has erected and put in operation at its blast furnace plant a new gantry crane for handling buckets for stocking and loading coal, coke and limestone; has built and equipped a new laboratory building, and is now building a new steel bridge across the Erie Canal. The Wickwire Limestone Company, a closely allied interest, has opened up a quarry at Gasport, N. Y., for a supply of fluxing stone. The company's acreage contains a deposit of approximately 5,000,000 tons of stone and the operation is entirely by Niagara Falls electric power. The equipment consists of an electrically driven No. 8 Traylor gyratory crusher, Westinghouse electric quarry locomotives, electrically driven Cyclone well drills, and Thew electric shovel. The Buffalo Iron Mining Company, another allied interest, has developed and opened up the Homer mine in Iron River, Mich., which is equipped with two electrically driven Ingersoll-Rand air compressors with a capacity of 3800 cu. ft. of air a minute, a Wellman-Seaver-Morgan Company electric hoist, a Sullivan air-driven hoist, Goulds Mfg. Company and Prescott electrically driven steam pumps and an 85-ft. steel headframe built by the Worden-Allen Company. The miners' dry and the power buildings are of fireproof construction. This deposit contains upwards of 2,000,000 tons of high-grade ore, and the development work, which is all that has been carried out to date, is constantly increasing this amount.

At its Lock Ridge furnaces at Alburtis, Pa., the Thomas Iron Company completed relining No. 8 furnace, putting in new steel hearth jacket and bosh jacket, and blew in the furnace on November 19. It also completed a new steel and concrete ore and coke trestle there, 80 ft. long, and laid with 90-lb. rails. At its Hokendauqua plant it is rebuilding No. 3 furnace with new hearth jacket, bosh jacket, complete new lining, bustle pipe, tuyere stocks, etc. The contract has been let for relining two 18 by 80-ft. hot blast stoves, two-pass with 7½-in. checkers. The Hokendauqua shops have been changed from steam power to electric power. At the Richard Mine, Wharton, N. J., the company has changed from steam pumps to electric pumps, and has installed two double units of Cameron electrically driven, two-stage centrifugal pumps, operated by alternating current motors. It has also discovered and partly developed a large vein of ore beyond the "offset" in the part of the property which had never been developed.

The Jackson Iron & Steel Company, Jackson, Ohio, put in a new steel trestle, steel bins and a skip hoist in the summer of 1914. The furnace was blown out for these improvements on June 24, and they were completed on November 1.

The Belfont Iron Works Company, Ironton, Ohio, made a number of improvements at its blast furnace, building a new steel trestle and a casting house and installing an electric crane. At its wire mill the company built a factory for manufacturing steel hoop kegs.

The Virginia Iron, Coal & Coke Company built a large steel tipple at its Toms Creek coal mine with a capacity of 500 tons per hr. Considerable additions to the power plant in the way of boilers, engines and generators were made. Work was begun on a coal washery with a capacity of 200 tons per hr. This will be in operation within 60 days. The only blast furnace improvement reported by the company was the installation of a General Electric turbo-blower with condensing plant equipped with electrical centrifugal water pumps and turbo-generators at the Crozer furnace plant in Roanoke, Va.

The Andrews & Hitchcock Iron Company, Youngstown, O., is still at work rebuilding its No. 2 Hubbard blast furnace and will have it ready for operation in February.

CANADIAN CONSTRUCTION

New construction and new installations at the plant of the Algoma Steel Corporation, Ltd., Sault Ste. Marie, Ontario, in 1914, were the following:

1000-ft. crib construction, concrete-capped ore dock.
New 7½-ton ore-handling bridge with transfer car.
Addition of two 45-ton open-hearth furnaces.
Motor drive for exhauster by-product building.
Improvement to storage and yard tracks.
Extension to centrifugal gas washer building.

Addition of cold saw and straightener, alterations to hot beds, and addition of shipping beds in merchant mills.

The Superior Rolling Mills Company, Ltd., has not yet started operations at Fort William, Ontario. The installation of the heating furnaces is about completed, but the manufacture of rolled products will not be under way until some time in 1915. The stock of the company is owned by the Steel Company of Canada, Ltd.

The Burlington Steel Company, Ltd., Hamilton, Ont., which rolls bars and special shapes, completed in 1914 the 8-in. mill which was begun in the previous year, and it was started in operation early in the summer.

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A Fair Prospect

Of one thing we may be well assured. The year upon which we have entered will not be as black as the one now behind us. We have definitely passed a period in which adverse influences culminated. All present conditions are favorable for a steady improvement. The mere replacement of ordinary stocks, now in process, must bring about a considerably increased volume of business. The experience of the opening months of 1914 will be repeated, but we are starting from a lower point and therefore have a greater distance to advance before the essential needs of the country can be covered. This should bring about both a larger volume of business and a more sustained buying movement. The condition of trade will then depend upon the amount of buying done by the railroads, the extent to which the nations now at war may draw upon the resources of this country to supply their needs and the revival of confidence among the people generally, which may result in an enlarged consumption of manufactured products. It would be an excess of pessimism to believe that the people of the United States would not show some disposition to make fresh ventures after so long a period of business lethargy. Yet we cannot ignore the restraining influence of existing tariff and revenue laws, the effect of which will be seen more plainly when European countries are again in position to compete in the export trade.

A retrospect of the year that has now become history recalls a series of untoward happenings, almost any of which would have been seriously depressing, but coming along so continuously formed a combination that almost strained our business fabric to the breaking point. It is true that failures of some importance occurred, but that there was neither widespread commercial ruin nor financial panic must be taken as proof that our commercial and financial institutions had been so thoroughly purged of expansion or inflation in the past few years of business persecution that the commercial fabric was almost down to its foundation stones and could not be further shaken. On this solid basis it should now be possible to rear a structure of improved trade, of renewed enterprise and even of some considerable achievement.

All this presupposes that 1915 has no disagreeable surprises or developments to discourage and dishearten business men. It is our habit, after some period of severe financial or business depression has passed, to comfort ourselves with the thought that the cause of the distressful condition has gone and that it is most unlikely to occur again. But every year eventually brings its own problems and on their solution depend our happiness and prosperity. We look back to 1914 and console ourselves with the reflection that we have to some extent tried out the new tariff and appreciate practically what it means; the protracted period of anti-trust legislation has come to an end and will probably not occupy the attention of Congress to any extent for a long time; the railroads have finally been accorded a measure of just treatment and are not likely for this year at least to be a depressing influence on general trade; an improved system of banking has been put in working order, so that lack of currency and exorbitant interest are not to be expected hereafter to accompany the moving of crops; while the European war may continue as a disturbing factor, there can be no such shock to the business and finances of the world as that which came with the sudden declaration of war last summer; with the better movement of ocean traffic, no repetition of the almost complete cessation of our foreign trade, such as that experienced last August and September, is to be expected.

The storms of 1914 have been weathered and the sky is again becoming brighter. Our foreign trade is expanding and our credit abroad is rising. Every month now sees a larger balance of trade in our favor. The low rate of exchange with European countries would cause gold to flow this way if our bankers willed it. We are in such improved financial condition that we are at last able to extend assistance to South American countries, through which their long expected purchase of our manufactured products may shortly begin. Money being the life-blood of trade, the condition of renewed health thus indicated cannot fail to impart fresh energy to the commercial body. The patient may require some time to feel confident of his steps, but that he is well on the way to recovery would appear to be established.

But what of the future? Has it no problems to be solved that may be in some measure a check to full business convalescence? It must be admitted that the horizon is not without some clouds, of greater or less portent. But those most plainly in view should not necessarily give us uneasiness. They are the Mexican question, the seizure of American vessels or cargoes by belligerents, and the harassing of business interests by further anti-trust prosecutions or through inquisitions by the Federal Trade Commission. Any one of these may

become a matter of moment, but all of them can be divested of their power for ill by the exercise of prudence, wisdom and reasonableness by the National Administration. Interference in Mexican affairs may eventually become necessary but it should not be undertaken until all hope of the establishment of a Mexican government by Mexicans shall have faded. The question of the seizure of American vessels or cargoes should never be permitted to get to the point of an ultimatum. If a plain violation of our anti-trust laws should be discovered, the Department of Justice should prosecute, but it should not attack a corporation on suspicion or on the mere hope of being able to make a case. The Federal Trade Commission should be composed of men selected for their knowledge of how actual business is conducted, their reputation for fairness and their freedom from fixed theories. Other developments than these which may affect business the coming year are much less likely to be of first importance. The year starts with much that is promising and it is to be hoped that nothing may happen to blight the fair prospect.

A Commission for Help or Hurt?

A number of steel manufacturers express their opinions in this issue of *The Iron Age* on questions raised by the new Federal Trade Commission act. The steel trade has had competition to the full for a good many months, including all of the calamitous twelve that ended last week. The Trade Commission act makes "unfair methods of competition in commerce" unlawful; but disastrous as the competitive pace has been in all steel products in these trying months, we have seen nowhere any call for the prompt exercise of the new commission's powers to bring any of the price-cutting steel manufacturers to book. Evidently public opinion is already settled as to one point—that while the naming of low prices in a definite territory to injure a particular seller or sellers would be promptly proceeded against, a general reign of prices leaving sellers without a living profit would be no ground for intervention by any arm of the Government.

The point is that in the common thinking the Federal Trade Commission act and the Clayton act do not look to the cure of the evils of unrestricted competition, but rather to imposing new restrictions upon business to the end that there may be more of that "protection of the public" at which all recent legislation has aimed.

The answers of steel manufacturers to our inquiry show a diversity that is natural in view of the vague definition of the Federal Trade Commission's duties. That it has broad powers of inquisition is obvious, but it is yet to be seen to what end these powers will be used. The letters on other pages are significant in being almost unanimous in favor of some form of co-operation in the steel trade, but it is doubted if any such arrangement will come to pass without further legislation. This suggests that at the recent Birmingham meeting of the American Iron and Steel Institute Judge Gary was warmly applauded when he urged that the principle of co-operation, as opposed to competitive warfare, should never be given up. However, he did not go to the extent of defining co-operation or indicating how it may practically be carried out in view of the political developments of the past few years, further than to say this: "It is a remarkable fact that the spirit which prompted you gentlemen seven years ago to bring about a competition that is fair has now been put by Congress in legal language and a commission has been appointed to see that the law is enforced."

A closer relation between the Government and business is plainly ahead. The question manufacturers are asking is how the great power that has been put into the hands of the Federal Trade Commission is going to be used. If the commission is composed largely of men of practical business experience, it can do much to lead the steel industry, all industry, out of a most serious situation. If men are appointed who have no idea of ending the war on business or of constructively going to work to make manufacturing profitable, the law will become only an instrument of harm. It is a matter of serious concern that most of the names reported under consideration represent types of men whose activities as members of such a commission would not be good for business. No Administration has had a graver responsibility than the new law imposes on the present one. Manufacturers have been encouraged by the way the European war has drawn Federal officials and industrial leaders together for the solution of this country's problems. It would be nothing short of a calamity if the make-up of the Trade Commission should be a notification that more harrying and inquisition are ahead, rather than definite plans to bring back prosperity.

Iron and Steel Price Comparisons

The long decline in iron and steel prices has been arrested lately and indications are that the next movement will be upward, though whether for a long or a short period is left to the future to determine. It becomes interesting, therefore, to compare recent prices with those obtaining at old low points. Until lately the lowest prices for steel products in modern times, the nearest approach to the historic low level of 1897 and 1898, were reached in the closing fortnight of November, 1911. Pig iron prices at the same time reached a very low level, but not altogether as low a level as in 1904. The following comparison of prices in the second half of November, 1911, and on December 31, 1914, is compiled from quotations in *The Iron Age*.

Iron and Steel Prices at Pittsburgh

	November, 1911	December 31, 1914	Change
Bessemer pig iron	$14.90	$14.70	—$0.20
Basic pig iron	13.15	13.45	+ .30
Foundry pig iron	13.90	13.70	— .20
Bessemer billets	19.00	19.00	.....
Open-hearth billets	18.50	19.00	+ .50
Bars	1.05c.	1.05c.	.....
Plates	1.10	1.05	— .05
Shapes	1.10	1.05	— .05
Wire nails	1.50	1.50	.....
Sheets, No. 28 black	1.85	1.80	— .05
Tin plate, 100-lb.	3.35	3.10	— .25

In the main the above table tells the whole story; but two observations should be added. One is that billets and sheet bars are now quoted lower at Youngstown than at Pittsburgh and thus the general price level in these unfinished commodities is about the same now as then. It should be noted also that in March, 1912, black sheets declined to 1.80c., or the same price as lately quoted. In general,

therefore, prices were just a perceptible trifle lower at the close of 1914 than at the memorable low point preceding the rise of 1912.

It may be of interest to trace briefly the course of the iron and steel market in recent years. The movement of 1909 was overdone, both in the extent to which prices were advanced and in the amount of material bought on contract and actually taken into stock. In consequence, there followed an unusually protracted decline; for in a general way the iron and steel trade usually loses ground for about as long a time as it has previously gained. The decrease in production extended to the close of 1910, but the decline in prices continued almost through the following year, and the lowest prices, falling in the latter part of November, 1911, came at a time when demand had increased. The competition was particularly keen, each mill endeavoring to reduce its production cost by taking on additional tonnage. Prices rose in December, but in February and March, 1912, there was a fresh recession, almost to the low point of November. Then began a continued and important advance, extending without interruption into October. The next year, 1913, was one of reaction. Prices held with considerable steadiness during the first half, but declined sharply in the second half, reaching a low point at the close of December. January and the early part of February brought advances, after which declines were resumed. July and August again brought advances, followed by declines. Thus the present low point is the third low point reached after the general and major decline from the rise of 1912, and it is the lowest of the three. In this respect the course of the market after the rise of 1912 was different from its course after the rise of 1909, for in the former instance there was one continuous decline, marked with scarcely an advancing ripple in the whole period. On account of particularly untoward conditions in the past year the rises could not gain headway. The buying movement centering in January was followed by a period of uncertainty on account of the railroad rate case, while that of June and July ran into the great war. According to present indications some fresh unfavorable factor will have to be developed if the present movement toward greater demand and higher prices is not to prove more or less continuous. This theory does not deny the possibility or probability of reactions but suggests that successive reactions will represent a loss of ground less than the amount previously gained.

The Output of Tubular Iron and Steel

The statistics of production of the various forms of iron and steel tubular goods in 1913 just reported by the American Iron and Steel Institute, and given in the news columns of *The Iron Age* last week, are of particular interest in view of the fact that no statistics of this sort had ever been gathered. While the total production of wrought iron and steel pipe and tubes was known approximately, from the skelp production figures, there was no definite knowledge of how the tonnage was distributed. There are probably very few except those intimately connected with the trade who would have supposed, for instance, that the quantity of the so-called "oil country goods" exceeded that of standard black pipe. Again, observing the frequent reports of orders placed for oil and gas lines, involving several thousands of tons frequently for a single line, one would hardly have imagined that the total tonnage of line pipe is very much smaller than that of oil country goods, embracing casing and various tubular items which are used in a sort of retail way.

The statistics of production in 1913 may be arranged for convenient comparison as follows:

Production of Wrought Tubular Goods—Gross Tons

Black standard pipe:		
Iron	120,619	
Steel	709,853	830,472
Galvanized standard pipe:		
Iron	25,323	
Steel	241,617	266,940
Oil country goods:		
Iron	84,778	
Steel	756,311	841,089
Line pipe, etc.:		
Iron	2,159	
Steel	177,052	179,211
Wrought boiler tubes:		
Iron	43,188	
Steel	84,632	127,820
Total welded:		
Iron	276,067	
Steel	1,969,465	2,245,532
Seamless tubes:		
Hot finished	42,740	
Cold drawn	65,827	108,567
Total wrought iron and steel, including seamless		2,354,099

The production of cast iron pipe amounted to 1,150,489 net tons, so that the total of all tubular products—wrought iron, wrought steel, welded or seamless, and cast iron—amounted to nearly 3,500,000 gross tons, and this is exclusive of 115,756 net tons of cast pipe fittings.

The preferences of buyers for wrought iron or steel in the case of welded tubular goods are somewhat interesting. In black standard pipe the wrought iron shows up particularly well, comprising almost 15 per cent. of the total. In the case of galvanized wrought pipe there is naturally much less preference for iron, and in this class iron comprises slightly less than 10 per cent. In oil country goods the proportion is just 10 per cent., while in line pipe, etc., the proportion is very small, indeed, not much over one per cent. In the grand total of welded tubular goods iron comprises a trifle over 12 per cent.

The War Demand for Lathes

Robert S. Alter, secretary and export manager of the American Tool Works Company, Cincinnati, Ohio, manufacturer of machine tools, was in England at the time the war broke out and confirms reports as to the heavy demand for small and medium-size lathes for finishing shrapnel cases. Owing to the accurate finish required, English manufacturers of war munitions show a preference for new tools. However, a large number of rebuilt machines have been exported from this country, he says, chiefly because deliveries could not be met on new machines. In discussing the after effects of the war, Mr. Alter holds that a large number of machine tools, especially lathes, will be dumped on the market in Europe and that it will take some time to absorb these into the regular manufacturing industries. He believes that eventually the war will be of benefit to the machine tool builders in the United States. Machinery from this country will be introduced into European shops where heretofore it has been little known.

FOR A TARIFF BOARD

Bills From Both Parties Looking to the Next Revision

WASHINGTON, D. C., January 5, 1915.—Legislation embracing a comprehensive overhauling of the tariff and revenue laws is now admitted by the leaders of both political parties of Congress to be so imminent as to call for immediate action in order that the serious economic blunders that have characterized both the Payne-Aldrich and the Underwood-Simmons laws may be avoided in the next general revision.

The deepest significance attaches to the fact that upon the same day in the past week Representative Mann, of Illinois, the leader of the Republican minority, and Representative Moss, of Indiana, a prominent Democratic member of the House, in absolute ignorance of each other's intentions, introduced in the House bills to create tariff boards, the chief function of which is to be the collection of reliable information to be used as the basis of the next revision of the revenue laws. In the preamble to a resolution by Mr. Mann directing the Committee on Ways and Means to report a bill for a tariff board Mr. Mann says that "a great majority of the American people believe in protecting and fostering home industries by a protective tariff sufficiently high, but not oppressively high"; that "a revision of the traiff along protective lines is certain to be had following the next national election and information for such revision ought properly to be obtained in advance"; and that "the proper rates for a protective tariff can best be ascertained by accurate and scientific investigation made by a permanent board of disinterested members and with a full knowledge thereby acquired reported to Congress."

While the language employed in the two bills is not identical, the general scope of the functions of the proposed board of five members is the same in both measures, the Moss bill describing them as follows:

> That it shall be the duty of said board to investigate the cost of production of all articles which by any act of Congress now in force or hereafter enacted are made the subject of tariff legislation, with special reference to the prices paid domestic and foreign labor and the prices paid for raw materials, whether domestic or imported, entering into manufactured articles, producers' prices and retail prices of commodities, whether domestic or imported, the cost of transportation from the place or places of production to the principal areas of consumption, the condition of domestic and foreign markets affecting the American products, including detailed information with respect thereto, together with all other facts which may be necessary or convenient in fixing import duties or in aiding the President and other officers of the Government in the administration of the customs laws, and said Board shall also make investigation of any such subject whenever directed by either house of Congress.

CHANGING SENTIMENT ON TARIFF AND REVENUE ACTS

Sentiment in favor of the scientific revision of the tariff by a non-partisan board is undoubtedly growing and remarkable evidence to this effect is being daily brought to the attention of the leaders here. Even the most experienced politicians are reaching the conclusion that while the ability to formulate the tariff laws on a partisan basis gives the party in power great influence along certain lines, nevertheless the responsibility thus assumed immediately becomes a disastrous source of weakness. As a straw showing the direction of the wind, public men here have been much impressed with the declaration made in the past week in favor of a tariff commission by so practical a political leader as Norman E. Mack, of Buffalo, for many years the New York member of the Democratic National Committee. Other prominent men in both parties are writing to their representatives here indorsing the project to take the tariff out of politics.

Another phase of the revenue question is giving the majority leaders great concern, namely, the widespread unpopularity of the war revenue emergency act, which has provoked a storm of criticism, directed about equally at the provisions of the law and at the methods adopted by the Internal Revenue Bureau for its enforcement. The leaders are now fully convinced that the enactment of this law in a time of peace was a blunder and that it would have been far wiser to have directed the Secretary of the Treasury to exercise his authority to sell Panama Canal bonds, of which $300,000,000 are available to meet any deficit.

Demands for repeal of the war revenue act are coming in from all parts of the country and are based not so much upon the unwillingness of the writers to aid the Government in maintaining its credit as upon the broader ground that the vexatious provisions of the law seriously hamper business in many directions. It is asserted with great emphasis that even should the estimates of the Congressional Committee be realized, amounting to $80,000,000, the benefit to the national credit thus obtained will be much more than offset by the effect of the vexing provisions upon commercial transactions. A bill providing for the repeal of the emergency act has already been introduced in the House and is receiving serious consideration. W. L. C.

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PIG IRON STILL DECLINES

December Output Only 1,515,752 Tons

Slight Increase in Capacity Active With No Change in Number of Stacks

Although the production of coke and anthracite pig iron fell off in December from the low point of November, the decrease was not as marked. In the month just ended the total production was 1,515,752 gross tons, or 48,896 tons per day, as compared with 1,518,316 tons in November, or 50,611 tons per day. As was the case in November the production of steel works furnaces fell off, but the decline was only about 2000 tons per day, against 5700 tons in November. The merchant furnaces on the other hand gained over 200 tons per day. The number of furnaces in blast at the beginning of January was 147, the same as that on December 1, and the capacity active was 48,848 tons per day against 48,464 tons per day on December 1.

DAILY RATE OF PRODUCTION

The daily rate of production of coke and anthracite pig iron by months, from December, 1913, is as follows:

Daily Rate of Pig-Iron Production by Months—Gross Tons

	Steel works	Merchant	Total
December, 1913	41,879	22,108	63,987
January, 1914	40,691	20,117	60,808
February	47,479	19,974	67,453
March	54,990	20,748	75,738
April	54,508	21,157	75,665
May	47,028	20,478	67,506
June	44,321	19,595	63,916
July	45,027	18,123	63,150
August	46,937	17,426	64,363
September	46,344	16,409	62,753
October	41,026	16,335	57,361
November	35,305	15,306	50,611
December	33,381	15,515	48,896

OUTPUT BY DISTRICTS

The accompanying table gives the production of all coke and anthracite furnaces in December and the three months preceding:

Monthly Pig-Iron Production—Gross Tons

	Sept. (30 days)	Oct. (31 days)	Nov. (30 days)	Dec. (31 days)
New York	109,569	112,818	113,675	126,271
New Jersey	8,559	6,860	6,910	6,973
Lehigh Valley	49,115	57,905	59,527	65,388
Schuylkill Valley	56,604	55,171	49,772	44,786
Lower Susquehanna and Lebanon Valley	31,217	33,988	33,674	30,836
Pittsburgh district	483,973	430,804	352,508	349,401
Shenango Valley	68,391	65,267	56,076	54,289
Western Pennsylvania	104,778	109,217	120,959	116,295
Maryland, Virginia and Kentucky	38,186	36,217	35,222	34,201
Wheeling district	80,289	75,014	51,593	52,194
Mahoning Valley	214,916	195,910	148,640	148,057
Central and Northern Ohio	126,208	130,473	130,850	117,473
Hanging Rock and S. W. Ohio	11,314	19,185	18,460	20,785
Chicago district	267,339	226,012	143,288	139,289
Mich., Minn., Mo., Wis. and Col.	63,258	49,518	41,355	49,944
Alabama	152,453	157,696	138,412	141,948
Tennessee	16,408	16,131	17,395	17,622
Total	1,882,577	1,778,186	1,518,316	1,515,752

PRODUCTION OF STEEL COMPANIES

Returns from all furnaces of the United States Steel Corporation and the various independent steel companies show the following totals of product month by month. Only steel-making iron is included in the figures below, together with ferromanganese, spiegeleisen and ferrosilicon. These last, while stated separately, are also included in the columns of "total production."

Production of Steel Companies—Gross Tons

	Pig, total production			Spiegeleisen, ferromanganese, etc.		
	1912	1913	1914	1912	1913	1914
Jan.	1,483,153	1,981,560	1,261,430	22,622	15,633	17,325
Feb.	1,550,995	1,792,154	1,329,414	15,950	20,131	10,524
Mar.	1,827,792	1,904,878	1,704,688	11,538	20,546	20,133
Apr.	1,830,717	1,939,751	1,635,226	11,104	23,108	18,676
May	1,922,557	1,991,192	1,457,847	20,518	19,042	21,504
June	1,823,958	1,860,070	1,329,623	26,685	19,212	16,254
July	1,803,205	1,840,216	1,395,851	26,522	22,310	16,524
Aug.	1,843,404	1,833,352	1,455,054	24,225	20,680	11,577
Sept.	1,773,073	1,828,232	1,390,322	22,484	24,555	13,786
Oct.	1,947,426	1,848,634	1,271,820	27,252	19,499	17,435
Nov.	1,884,524	1,573,007	1,059,159	17,461	26,765	21,977
Dec.	1,976,870	1,298,262	1,034,802	18,523	14,095	20,733

CAPACITY IN BLAST JANUARY 1 AND DECEMBER 1.

The following table shows the daily capacity in gross tons, of furnaces in blast January 1 and December 1, by districts:

Coke and Anthracite Furnaces in Blast

Location of furnaces	Total number of stacks	Jan. 1 Number in blast	Jan. 1 Capacity per day	Dec. 1 Number in blast	Dec. 1 Capacity per day
New York:					
Buffalo	19	10	3,421	10	3,338
Other New York	7	2	433	2	451
New Jersey	7	1	219	1	230
Pennsylvania:					
Lehigh Valley	22	7	1,876	7	1,311
Spiegel	2	2	180	2	177
Schuylkill Val.	16	4	1,445	4	1,411
Lower Susquehanna	7	2	438	2	557
Lebanon Valley	10	3	557	3	565
Pittsburgh Dist.	52	23	10,737	23	10,688
Ferro.	4	2	285	2	239
Shenango Val.	19	5	1,751	5	1,869
Western Pa.	26	11	3,726	11	3,970
Ferro.	1	1	25	1	125
Maryland	4	1	388	1	366
Wheeling District.	11	5	1,684	5	1,719
Ohio:					
Mahoning Val.	25	12	5,268	11	4,885
Central and Northern	24	9	3,553	10	4,069
Hanging Rock & S. W. Ohio	15	5	866	5	715
Ill. and Ind.	34	11	4,522	10	4,356
Ferro.	2	1	99	1	70
Michigan, Wis. & Minn.	10	4	1,086	3	768
Colo. and Mo.	7	1	586	2	695
Ferro.	1	1	38	0	0
The South:					
Virginia	24	3	407	3	431
Kentucky	5	1	197	2	377
Alabama	45	15	4,538	15	4,344
Ferro.	1	1	41	1	68
Tennessee	20	4	482	5	580
Total	423	147	48,848	147	48,464

DIAGRAM OF PIG-IRON PRODUCTION AND PRICES

The fluctuations in pig-iron production from January, 1907, to the present time are shown in the accompanying chart. The figures represented by the heavy lines are those of daily average production, by months, of coke and anthracite iron. The two other curves on the chart represent monthly average prices of Southern No. 2 foundry pig iron at Cincinnati and of local No. 2 foundry iron at furnace at Chicago. They are based on the weekly market quotations of *The Iron Age*. The figures for daily average production are as follows:

Daily Average Production of Coke and Anthracite Pig Iron in the United States by Months Since January 1, 1907—Gross Tons

	1907	1908	1909	1910	1911	1912	1913	1914
Jan.	71,149	33,918	57,975	84,148	56,752	66,384	90,172	60,808
Feb.	73,038	37,163	60,976	85,616	64,090	72,442	92,369	67,453
Mar.	71,821	39,619	59,232	84,459	70,036	77,591	89,147	75,738
Apr.	73,885	38,289	57,962	82,792	68,836	79,181	91,759	75,665
May	74,048	37,603	60,753	77,102	61,079	81,051	91,039	67,506
June	74,486	36,444	64,656	75,516	59,585	81,358	87,619	63,916
July	72,763	39,287	67,793	69,305	57,841	77,738	82,601	63,150
Aug.	72,594	42,851	72,546	67,963	62,150	81,046	82,057	64,363
Sept.	72,783	47,300	79,507	68,476	65,903	82,128	83,531	62,753
Oct.	75,386	50,554	83,856	67,520	67,811	86,722	82,133	57,361
Nov.	60,927	51,595	84,917	63,659	66,648	87,697	74,453	50,611
Dec.	39,815	56,158	85,022	57,349	65,912	89,766	63,987	48,896

THE RECORD OF PRODUCTION

Production of Coke and Anthracite Pig Iron in the United States by Months Since January 1, 1910—Gross Tons

	1910	1911	1912	1913	1914
Jan.	2,608,605	1,759,326	2,057,911	2,795,331	1,885,054
Feb.	2,397,254	1,794,509	2,100,815	2,586,337	1,888,670
Mar.	2,617,949	2,171,111	2,405,318	2,763,563	2,347,867
Apr.	2,483,763	2,064,086	2,375,436	2,752,761	2,269,955
May	2,390,180	1,893,456	2,512,582	2,822,217	2,092,686
June	2,265,478	1,787,566	2,440,745	2,628,565	1,917,783
July	2,148,442	1,793,068	2,410,889	2,560,646	1,957,645
Aug.	2,106,847	1,926,637	2,512,431	2,545,763	1,995,261
Sept.	2,056,275	1,997,102	2,463,839	2,505,927	1,882,577
Oct.	2,093,121	2,102,147	2,689,933	2,546,261	1,778,186
Nov.	1,909,780	1,999,433	2,630,854	2,233,123	1,518,316
Dec.	1,777,817	2,043,270	2,782,737	1,983,607	1,515,752

Among the furnaces blown in last month were one Bethlehem in the Lehigh Valley, one Aliquippa in the Pittsburgh district, one Ohio in the Mahoning Valley, Marting in the Hanging Rock district, one Gary in the Chicago district, one Zug in Michigan and one Colorado.

The furnaces blown out in December include one Crane in the Lehigh Valley, which was banked, this group now being entirely inactive; one Aliquippa in the Pittsburgh district, Ashland in Kentucky, one National Tube in northern Ohio, one Iroquois in the Chicago district, Johnson City in Tennessee and one Colorado.

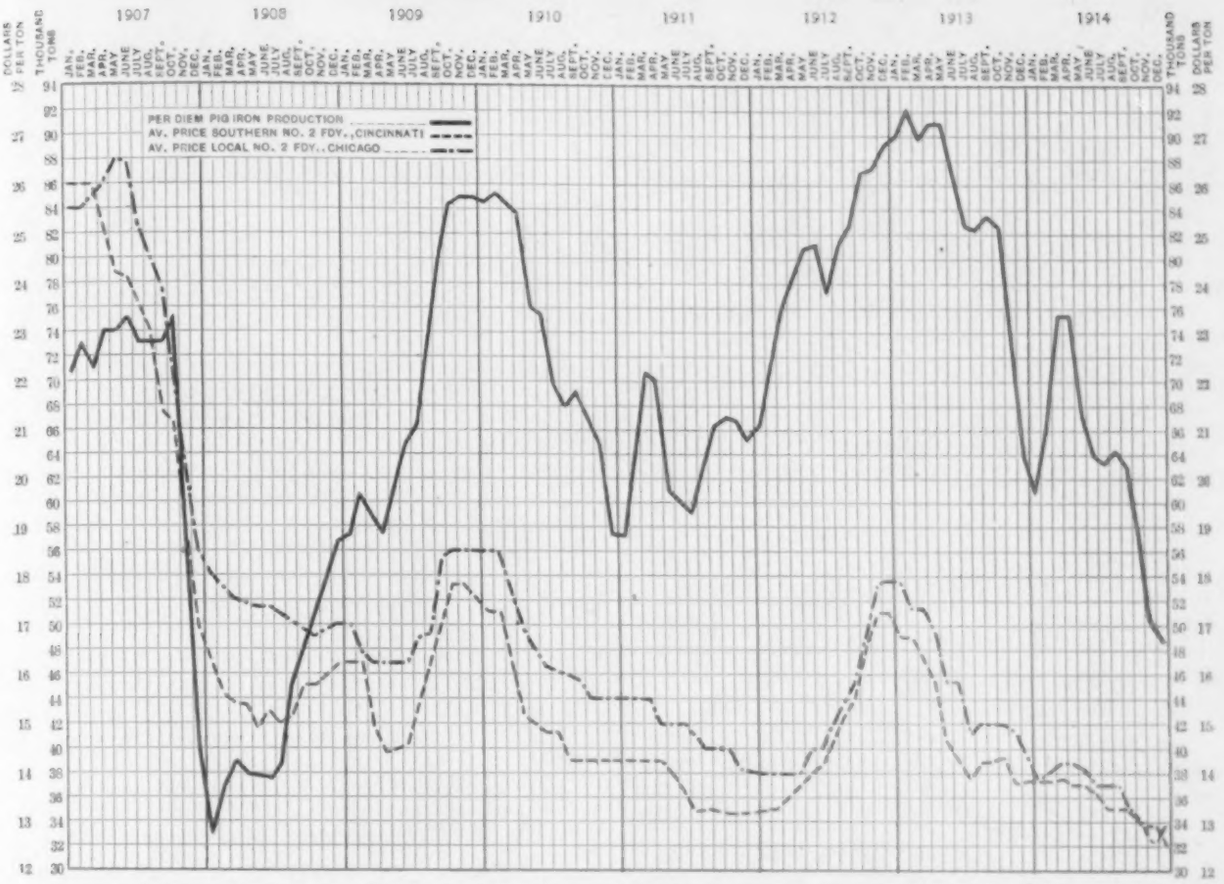


Diagram of Daily Average Production by Months of Coke and Anthracite Pig Iron in the United States from January 1, 1907, to January 1, 1915; Also of Monthly Average Prices of Southern No. 2 Foundry Iron at Cincinnati and Local No. 2 Foundry Iron at Chicago District Furnace

Pittsburgh and Nearby Districts

The Pittsburgh Steel Company, Frick Building, Pittsburgh, which has two blast furnaces, open-hearth steel works and rod and wire-nail mills at Monessen and hoop and band mills at Glassport, Pa., has sold to the Union Trust Company, Pittsburgh, an issue of $5,000,000 6 per cent. notes, of which $1,500,000 will mature January 1, 1918, $1,500,000 January 1, 1919, and $2,000,000 January 1, 1920. By this transaction the company provides for all of its indebtedness and also secures ample working capital. It has agreed that its quick assets shall at all times be not less than the amount of the notes outstanding. The Union Trust Company will be the trustee under the indenture securing the notes.

The Youngstown Sheet & Tube Company, Youngstown, Ohio, has bought about 100 acres west of its present plant, including a site on which are some buildings formerly of the American Bridge Company. The price paid was considerably less than $500,000. The company has sold a part of the land to the Pittsburgh & Lake Erie Railroad for yard purposes and another part to the Pennsylvania Lines West. It is probable that the remainder will be held for plant extensions.

The McKeesport Tin Plate Company, McKeesport, Pa., will increase its capital from $1,200,000 to $3,000,000. It has a 22 hot-mill tin-plate plant, but proposes to add 20 more mills. The completion of these would give the company the distinction of having the largest individual tin-plate plant in the country. Definite plans for the 20 new mills will be completed shortly.

The tin-plate plant of the American Sheet & Tin Plate Company at Farrell, Pa., containing 20 hot mills, is operating in full for the first time in several months.

The property of the Riverside Engine Company, Oil City, Pa., which has been idle for several years, has been taken over by the Oil City Foundry Company and the plant will soon be put in operation.

The puddling plant of the A. M. Byers Company, Girard, Ohio, which has been down for some time, has been started in part, 42 puddling furnaces being in operation. These will be operated on four six-hour turns in order to give as many men work as possible.

The Cambria Steel Company, Johnstown, Pa., has filed plans for a 2110-ft. slag wall along the east bank of the Conemaugh River. It will be built to give more room for plant extensions.

The annual dinner of officials and heads of departments of the Carnegie Steel Company was held in the Hotel Schenley, Pittsburgh, on the evening of January 2. James A. Farrell, president United States Steel Corporation, was present. Col. H. P. Bope, vice-president and general manager of sales of the Carnegie Company, who was toastmaster, talked on "Commercial Tendencies of Officials." Dr. John S. Unger, chief of the metallurgical department of the Steel Corporation, discussed details of his work; W. G. Clyde, assistant general manager of sales, spoke on "Personality in Salesmanship," and Judge J. H. Reed, chairman of the board, had for his topic, "Of the Making of Laws, There Is No End."

The Morgan continuous merchant mill, built by the Morgan Construction Company, Worcester, Mass., for the Pittsburgh Crucible Steel Company, Midland, Pa., was started on Monday, January 4. This mill has a 14-in. roughing stand and the finishing stands are 12 in. to 8 in. The mill will roll ⅜-in. to 2-in. rounds, various squares and merchant flats. It is housed in a steel building, 120 x 900 ft.

J. Willis Dalzell, 406 House Building, Pittsburgh, has taken the sales agency in the Pittsburgh district for the Republic Structural Iron Works, Cleveland, for its reinforcing bars.

J. P. Baird, president National Roll & Foundry Company, Avonmore, Pa., has been granted patents on his water-cooled standings for hot mills, which were illustrated in *The Iron Age* of January 8, 1914.

The Nashville, Chattanooga & St. Louis has ordered 10 mikado and 6 Pacific type locomotives from the Baldwin Locomotive Works.

The Iron and Metal Markets

A START IN RAIL BUYING

One or Two Orders Taken by Canada

Pig-Iron Production in 1914 Close to 23,300,000 Tons

The steel trade has drifted quietly into the new year. December buying in bars, plates and shapes was liberal in comparison with November, and the advance to 1.10c., Pittsburgh, which all important producers announced, to be effective January 1, led to a fair amount of covering at lower figures.

Mill operations this week have naturally shown rather better schedules than those of the holidays, but the increase is not pronounced.

Actual and prospective buying by the railroads has had a good deal of publicity, particularly as to rails. A 40,000-ton order has been placed by the Louisville & Nashville with the Tennessee Company. The Pere Marquette has bought 10,000 tons and the Reading has placed some business, including 2500 tons at Pittsburgh. The Pennsylvania order is expected to be placed soon and the New York Central is making up its requirements.

Much has been made in current news of the rail contracts thus far placed, but 170,000 tons was bought by two lines at the opening of 1914, or considerably more than has been reported for the past two weeks.

The Pere Marquette order has been widely advertised as going to a Canadian mill. Its tariff phase is interesting, since $25 at mill, or $26.50 at lower lake port, was charged for the rails to be delivered in the United States, while $30 was the mill price on the Canadian part of the order. Canada's rail tariff is $7. Another Central Western road, which earlier in the year had a low price from the Ontario mill, but did not buy there, is understood again to have Canadian prices below those of domestic rail mills.

The report of a purchase of 10,000 tons of Canadian rails by an Eastern road lacks definite confirmation.

Probably 250,000 tons of rails are now under consideration as against 300,000 tons referred to in the same way in the market reports of the first week of 1914.

Some good spike contracts have been closed at Pittsburgh, including 20,000 kegs for the Pennsylvania Lines West and 10,000 kegs for the B. & O. Two 1000-car inquiries have come up in the Middle West. These cars were conditionally placed some months ago, but could not be financed.

More activity in new structural work is reported in districts apart from the East and fabricators look for some improvement. The Pennsylvania Railroad is taking bids on a part of its bridge steel requirements for 1915.

The Steel Corporation's new orders in December averaged close to 30,000 tons a day, figuring in tin plate and other long time contracts. Its shipments were well under that figure, so that a very considerable increase in unfilled orders will be reported.

Pig-iron production in December was 1,515,752 tons, or 48,896 tons a day, as compared with 1,518,316 tons in November, or 50,611 tons a day. On January 1 with 147 furnaces in blast the active capacity was 48,848 tons a day, against 48,464 tons a day for the same number of furnaces on December 1. Six furnaces blew in and six furnaces blew out in the month.

The production of coke and anthracite pig iron in the second half of 1914 was 10,647,737 gross tons. In the first half the production of all kinds of pig iron was 12,536,094 tons. Estimating charcoal iron in the second half at 115,000 tons, the total for the year is about 23,300,000 tons, as against 30,966,000 tons in 1913 and 29,727,000 tons in 1912.

A Comparison of Prices

Advances Over the Previous Week in Heavy Type, Declines in Italics

At date, one week, one month, and one year previous.

	Jan. 6, 1915.	Dec. 30, 1914.	Dec. 9, 1914.	Jan. 7, 1914.
Pig Iron, Per Gross Ton:				
No. 2 X, Philadelphia...	$14.25	$14.25	$14.25	$14.85
No. 2, Valley furnace....	13.00	13.00	12.75	13.00
No. 2 Southern, Cin'ti...	12.40	12.40	12.65	14.00
No. 2, Birmingham, Ala.	9.50	9.50	9.75	10.75
No. 2, furnace, Chicago*	**13.00**	12.75	13.00	14.00
Basic, del'd, eastern Pa.	13.50	13.50	13.50	14.00
Basic, Valley furnace...	12.50	12.50	12.50	12.50
Bessemer, Pittsburgh....	14.70	14.70	14.70	15.15
Malleable Bess., Ch'go*..	**13.00**	12.75	13.00	14.00
Gray forge, Pittsburgh..	13.45	13.45	13.40	13.90
L. S. charcoal, Chicago..	15.75	15.75	15.75	15.25
Billets, etc., Per Gross Ton:				
Bess. billets, Pittsburgh..	19.00	19.00	19.00	20.00
O.-h. billets, Pittsburgh..	19.00	19.00	19.00	20.00
O.-h. sheet bars, P'gh...	20.00	20.00	19.50	21.00
Forging billets, base, P'gh.	24.00	24.00	24.00	24.00
O.-h. billets, Phila.....	21.40	21.40	21.40	21.50
Wire rods, Pittsburgh...	25.00	25.00	25.00	25.00
Old Material, Per Gross Ton:				
Iron rails, Chicago.....	11.25	11.25	11.00	13.00
Iron rails, Philadelphia..	13.00	13.00	13.00	15.50
Carwheels, Chicago	9.75	9.75	9.50	11.50
Carwheels, Phfladelphia.	**11.00**	10.50	10.00	12.00
Heavy steel scrap, P'gh.	**11.50**	11.25	10.50	10.50
Heavy steel scrap, Phila.	**10.00**	9.50	9.25	10.00
Heavy steel scrap, Ch'go	**9.00**	8.75	8.25	9.00
No. 1 cast, Pittsburgh...	11.25	11.25	10.50	10.75
No. 1 cast, Philadelphia.	**12.00**	11.75	11.00	12.00
No. 1 cast, Ch'go (net ton)	9.25	9.25	9.00	10.00
Finished Iron and Steel,				
Per Lb. to Large Buyers:	Cents.	Cents.	Cents.	Cents.
Bess. rails, heavy, at mill	1.25	1.25	1.25	1.25
Iron bars, Philadelphia..	1.17½	1.17½	1.17½	1.20
Iron bars, Pittsburgh....	1.15	1.15	1.15	1.35
Iron bars, Chicago.....	**0.97½**	0.95	0.90	1.10
Steel bars, Pittsburgh...	**1.10**	1.05	1.10	1.20
Steel bars, New York..	**1.26**	1.21	1.26	1.36
Tank plates, Pittsburgh.	**1.10**	1.05	1.05	1.20
Tank plates, New York.	**1.26**	1.21	1.26	1.36
Beams, etc., Pittsburgh.	**1.10**	1.05	1.10	1.20
Beams, etc., New York..	**1.26**	1.21	1.26	1.36
Skelp, grooved steel, P'gh	1.10	1.10	1.10	1.20
Skelp, sheared steel, P'gh	1.15	1.15	1.15	1.30
Steel hoops, Pittsburgh..	1.20	1.20	1.25	1.35
Sheets, Nails and Wire,				
Per Lb. to Large Buyers:	Cents.	Cents.	Cents.	Cents.
Sheets, black, No. 28, P'gh	1.80	1.80	1.85	1.85
Galv. sheets, No. 28, P'gh	2.75	2.75	2.80	2.85
Wire nails, Pittsburgh..	1.50	1.50	1.50	1.50
Cut nails, Pittsburgh....	1.50	1.50	1.55	1.55
Fence wire, base, P'gh..	1.30	1.30	1.30	1.30
Barb wire, galv., P'gh...	1.90	1.90	1.90	1.90

*The average switching charge for delivery to foundries in the Chicago district is 50c. per ton.

Coke, Connellsville, Per Net Ton at Oven:	Jan. 6, 1915.	Dec. 30, 1914.	Dec. 9, 1914.	Jan. 7, 1914.
Furnace coke, prompt	$1.50	$1.50	$1.50	$1.85
Furnace coke, future	1.75	1.75	1.75	2.00
Foundry coke, prompt	2.00	1.90	1.90	2.50
Foundry coke, future	2.15	2.15	2.15	2.60

Metals, Per Lb. to Large Buyers:	Cents.	Cents.	Cents.	Cents.
Lake copper, New York	13.50	13.50	13.00	15.12½
Electrolytic copper, N. Y.	13.00	13.00	12.75	14.87½
Spelter, St. Louis	5.60	5.40	5.50	5.15
Spelter, New York	5.75	5.55	5.65	5.30
Lead, St. Louis	3.60	3.62½	3.67½	4.05
Lead, New York	3.80	3.80	3.80	4.15
Tin, New York	33.25	33.25	32.50	36.60
Antimony, Hallett's, N. Y.	14.00	14.00	15.00	7.00
Tin plate, 100-lb. box, P'gh	$3.10	$3.10	$3.20	$3.40

Finished Iron and Steel f. o. b. Pittsburgh

Freight rates from Pittsburgh in carloads, per 100 lb.: New York, 16c.; Philadelphia, 15c.; Boston, 18c.; Buffalo, 11.6c.; Cleveland, 10.5c.; Cincinnati, 15.8c.; Indianapolis, 17.9c.; Chicago, 18.9c.; St. Louis, 23.6c.; Kansas City, 43.6c.; Omaha, 43.6c.; St. Paul, 32.9c.; Denver, 68.6c.; New Orleans, 30c.; Birmingham, Ala., 45c.; Pacific coast, 80c. on plates, structural shapes and sheets No. 11 and heavier; 85c. on sheets Nos. 12 to 16; 95c. on sheets No. 16 and lighter; 65c. on wrought pipe and boiler tubes. The foregoing rates to the Pacific coast are by rail. The rate via New York and the Panama Canal on plates, shapes, etc., is 46c.

Plates.—Tank plates, ¼ in. thick, 6¼ in. up to 100 in. wide, 1.10c., base, net cash, 30 days. Following are stipulations prescribed by manufacturers:

Rectangular plates, tank steel or conforming to manufacturer's standard specifications for structural steel dated February 6, 1903, or equivalent, ¼ in. and over on thinnest edge, 100 in. wide and under, down to but not including 6 in. wide, are base.

Plates up to 72 in. wide, inclusive, ordered 10.2 lb. per sq. ft., are considered ¼-in. plates. Plates over 72 in. wide must be ordered ¼ in. thick on edge, or not less than 11 lb. per sq. ft., to take base price. Plates over 72 in. wide ordered less than 11 lb. per sq. ft. down to the weight of 3-16 in. take the price of 3-16 in.

Allowable overweight, whether plates are ordered to gauge or weight, to be governed by the standard specifications of the Association of American Steel Manufacturers.

Extras	Cents per lb.
Gauges under ¼ in. to and including 3-16 in	.10
Gauges under 3-16 in. to and including No. 8	.15
Gauges under No. 8 to and including No. 9	.25
Gauges under No. 9 to and including No. 10	.30
Gauges under No. 10 to and including No. 12	.40
Sketches (including straight taper plates), 3 ft. and over	.10
Complete circles 3 ft. in diameter and over	.20
Boiler and flange steel	.10
"A. B. M. A." and ordinary firebox steel	.20
Still bottom steel	.30
Marine steel	.40
Locomotive firebox steel	.50
Widths over 100 in. up to 110 in., inclusive	.05
Widths over 110 in. up to 115 in., inclusive	.10
Widths over 115 in. up to 120 in., inclusive	.15
Widths over 120 in. up to 125 in., inclusive	.25
Widths over 125 in. up to 130 in., inclusive	.50
Widths over 130 in	1.00
Cutting to lengths, under 3 ft. to 2 ft. inclusive	.25
Cutting to lengths, under 2 ft. to 1 ft. inclusive	.50
Cutting to lengths, under 1 ft	1.55

No charge for cutting rectangular plates to lengths 3 ft. and over.

Structural Material.—I-beams, 3 to 15 in.; channels, 3 to 15 in.; angles, 3 to 6 in. on one or both legs, ¼ in. thick and over, and zees, 3 in. and over, 1.10c. Extras on other shapes and sizes are as follows:

	Cents per lb.
I-beams over 15 in	.10
H-beams over 18 in	.10
Angles over 6 in., on one or both legs	.10
Angles, 3 in .on one or both legs, less than ¼ in. thick, as per steel bar card, Sept. 1, 1909	.70
Tees, structural sizes (except elevator, handrail, car truck and conductor rail)	.05
Channels and tees, under 3 in. wide, as per steel bar card, Sept. 1, 1909	.20 to .80
Deck beams and bulb angles	.30
Hand rail tees	.75
Cutting to lengths, under 3 ft. to 2 ft. inclusive	.25
Cutting to lengths, under 2 ft. to 1 ft. inclusive	.50
Cutting to lengths, under 1 ft	1.55

No charge for cutting to lengths 3 ft. and over.

Wire Products.—Fence wire, Nos. 0 to 9, per 100 lb., terms 60 days or 2 per cent. discount in 10 days, carload lots to jobbers, annealed, $1.30; galvanized, $1.70. Galvanized barb wire and fence staples to jobbers, $1.90; painted, $1.50. Wire nails to jobbers, $1.50. Woven wire fencing, 73 per cent. off list for carloads; 72 off for 1000-rod lots; 71 off for less than 1000-rod lots.

The following table gives the price to retail merchants on fence wire in less than carloads, with the extras added to the base price:

Plain Wire, per 100 lb.

Nos.	0 to 9	10	11	12&12½	13	14	15	16
Annealed	$1.45	$1.50	$1.55	$1.60	$1.70	$1.80	$1.90	$2.00
Galvanized	1.85	1.90	1.95	2.00	2.10	2.20	2.60	2.70

Wire Rods.—Bessemer, open-hearth and chain rods, $25.

Wrought Pipe.—The following are the jobbers' carload discounts on the Pittsburgh basing card on steel pipe in effect from November 2, 1914, and iron pipe from June 2, 1913, all full weight:

Butt Weld

Steel, Inches	Black	Galv.	Iron, Inches	Black	Galv.
⅛, ¼ and ⅜	74	53½	⅛ and ¼	66	47
½	78	67½	⅜	65	46
¾ to 3	81	72½	½	69	56
			¾ to 2½	72	61

Lap Weld

2	78	69½	1¼	56	45
2½ to 6	80	71½	1½	67	56
7 to 12	77	66½	2	68	58
13 and 14	63½	..	2½ to 4	70	61
15	61	..	4½ to 6	70	61
			7 to 12	68	55

Reamed and Drifted

1 to 3, butt	79	70½	1 to 1½, butt	70	59
2, lap	76	67½	2, butt	70	59
2½ to 6, lap	78	69½	1¼, lap	54	43
			1½, lap	65	54
			2, lap	66	56
			2½ to 4, lap	68	59

Butt Weld, extra strong, plain ends

⅛, ¼ and ⅜	69	58½	⅜	63	52
½	74	67½	½	67	60
¾ to 1½	78	71½	¾ to 1½	71	62
2 to 3	79	72½	2 and 2½	72	63

Lap Weld, extra strong, plain ends

2	75	66½	1½	65	59
2½ to 4	77	68½	2	66	58
4½ to 6	76	67½	2½ to 4	70	61
7 to 8	69	58½	4½ to 6	69	60
9 to 12	64	53½	7 to 8	63	53
			9 to 12	58	47

Butt Weld, double extra strong, plain ends

½	64	57½	½	57	49
¾ to 1½	67	60½	¾ to 1½	60	52
2 to 2½	69	62½	2 and 2½	62	54

Lap Weld, double extra strong, plain ends

2	65	58½	2	55	49
2½ to 4	67	60½	2½ to 4	60	54
4½ to 6	66	59½	4½ to 6	59	53
7 to 8	59	48½	7 to 8	52	42

To the large jobbing trade an additional 5 per cent is allowed over the above discounts.

The above discounts are subject to the usual variation in weight of 5 per cent. Prices for less than carloads are two (2) points lower basing (higher price) than the above discounts on black and three (3) points on galvanized.

Boiler Tubes.—Discounts to jobbers, in carloads, in effect from May 1, 1914, on steel and from January 2, 1914, on iron, are as follows:

Lap Welded Steel		*Standard Charcoal Iron*	
1¾ and 2 in	62	1½ in	45
2¼ in	59	1¾ and 2 in	49
2½ and 2¾ in	65	2¼ in	45
3 and 3¼ in	70	2½ to 2¾ in	54
3½ and 4½ in	72	3 and 3¼ in	57
5 and 6 in	65	3½ and 4½ in	60
7 to 13 in	62	5 and 6 in	49

Locomotive and steamship special charcoal grades bring higher prices.

2½ in. and smaller, over 18 ft., 10 per cent. net extra.

2¾ in. and larger, over 22 ft., 10 per cent. net extra.

Less than carloads will be sold at the delivered discounts for carloads, lowered by two points for lengths 22 ft. and under to destinations east of the Mississippi River; lengths over 22 ft., and all shipments going west of the Mississippi River must be sold f.o.b. mill at Pittsburgh basing discount, lowered by two points. On standard charcoal iron tubes for desirable orders the above discounts are shaded an extra 5, and occasionally two 5's by some makers.

Sheets.—Makers' prices for mill shipment on sheets of U. S. Standard gauge, in carload and larger lots, on which jobbers charge the usual advance for small lots from store, are as follows, f.o.b. Pittsburgh, terms 30 days net, or 2 per cent. cash discount in 10 days from date of invoice:

Blue Annealed Sheets

	Cents per lb.
Nos. 8 to 8	1.25 to 1.30
Nos. 9 to 10	1.30 to 1.35
Nos. 11 and 12	1.35 to 1.40
Nos. 13 and 14	1.45 to 1.50
Nos. 15 and 16	1.55 to 1.60

Box Annealed Sheets, Cold Rolled

	Cents per lb.
Nos. 10 and 11	1.45 to 1.50
No. 12	1.45 to 1.50
Nos. 13 and 14	1.50 to 1.55
Nos. 15 and 16	1.55 to 1.60
Nos. 17 to 21	1.60 to 1.65
Nos. 22 and 24	1.65 to 1.70
Nos. 25 and 26	1.70 to 1.75
No. 27	1.75 to 1.80
No. 28	1.80 to 1.85
No. 29	1.85 to 1.90
No. 30	1.95 to 2.00

Galvanized Sheets of Black Sheet Gauge

	Cents per lb.
Nos. 10 and 11	1.75 to 1.80
No. 12	1.85 to 1.90
Nos. 13 and 14	1.85 to 1.90
Nos. 15 and 16	2.00 to 2.05
Nos. 17 to 21	2.15 to 2.20
Nos. 22 and 24	2.30 to 2.35
Nos. 25 and 26	2.45 to 2.50
No. 27	2.60 to 2.65
No. 28	2.75 to 2.80
No. 29	2.90 to 2.95
No. 30	3.05 to 3.10

Pittsburgh

PITTSBURGH, PA., January 5, 1915.

Sales agents of large steel companies report that 1915 has opened auspiciously. The outlook indicates that heavy bookings of material will be made in January for first quarter and first half delivery. There has already been good buying of plates, shapes, steel bars, sheets, railroad spikes and shafting. The coke market is quiet as active consumers are well covered. The scrap trade is active and strong.

Pig Iron.—Among new inquiries is one for 4000 to 5000 tons of foundry iron for the Westinghouse Machine Company for first half delivery. The recent inquiry of the Marshall Foundry Company for 3000 to 6000 tons of Bessemer for first quarter has been dropped. The Westinghouse Electric & Mfg. Company is in the market for its requirements of foundry pig iron for second, third and fourth quarters for its North Side foundry only, not buying for its Cleveland works. It is estimated the inquiry involves 20,000 to 25,000 tons or more. The company says it may need some No. 1 iron for first quarter and asks prices on this grade. We quote Bessemer iron at $13.75; basic, $12.50; malleable Bessemer, $12.75; No. 2 foundry, $13 to $13.25, and gray forge, $12.50, all at Valley furnace, with a freight rate of 95c. a ton for delivery in the Cleveland and Pittsburgh districts.

W. P. Snyder & Co., Pittsburgh, announce that, based on sales of 1000 tons or more, the average price of Bessemer pig iron sold in December was $13.75 and of basic iron $12.50, both at Valley furnace. The Bessemer average for the year was $13.9793, which is $2.21 below the Bessemer average of 1913 and $1.11 below 1912. The basic average for the year was $12.854, which is $1.77 below the average for 1913 and $1.15 below 1912.

Billets and Sheet Bars.—There has been further covering on contracts for sheet bars by sheet and tin-plate mills for first quarter. New inquiry for billets is fairly active. Orders booked by the billet and rail bureau of the Carnegie Steel Company in December showed a heavy increase over November. We quote Bessemer and open-hearth billets at $18.50, and Bessemer and open-hearth sheet bars $19, f.o.b. maker's mill, Youngstown; Bessemer and open-hearth billets, $19, and Bessemer and open-hearth sheet bars, $20, f.o.b. maker's mill, Pittsburgh. Forging billets are quoted at $24 for sizes up to but not including 10 x 10 in., and for carbons up to 0.25, the regular extras being charged for larger sizes and higher carbons. Forging billets running above 0.25 to 0.60 carbon take $1 per ton extra. Axle billets are quoted at $21 to $22.

Ferroalloys.—There is no new inquiry for ferromanganese and no sales have recently been made here. Consumers are well covered for first quarter and in some cases first half. We quote 50 per cent. ferrosilicon, in lots up to 100 tons, at $73; over 100 tons to 600 tons, $72; over 600 tons, $71, delivered in the Pittsburgh district. On 10 per cent. ferrosilicon the quotation is $19; 11 per cent., $20, and 12 per cent., $21, f.o.b. cars Jackson County, Ohio, or Ashland, Ky., furnace. We quote 20 per cent. spiegeleisen at $25 at furnace. We quote ferrotitanium at 8c. per lb. in carloads; 10c. in 2000-lb. lots and over, and 12½c. in less than 2000-lb. lots.

Steel Rails.—It is asserted positively that the Pennsylvania Railroad will be in the market for its requirements of rails for 1915 within 10 days or two weeks. The Carnegie Steel Company has taken 2500 tons for the Philadelphia & Reading and has about closed with the Cincinnati, Hamilton & Dayton for 4000 tons. This company has also sold to the government of Greece 5000 tons of standard section rails and 130,000 steel railroad ties. The new demand for light rails is dull. We quote standard section rails made of Bessemer stock at 1.25c., and of open-hearth, 1.34c., f.o.b. Pittsburgh. We quote light rails as follows, in carload lots: 8 and 10 lb. sections, 1.275c.; 12 and 14 lb., 1.225c.; 16 and 20 lb., 1.175c.; 25, 30, 35, 40 and 45 lb. sections, 1.125c.

Structural Material.—Inquiry is active and a good deal of business has been closed. Prices are still low and fabricators claim they leave little if any margin of profit. The Jones & Laughlin Steel Company has taken 1200 tons for alterations to a cooling plant at the Pittsburgh-Union Stock Yards on Herrs Island in this city and will also furnish 1600 tons of plain material for ore bins and trestles for Corrigan, McKinney & Co. at Cleveland, to be fabricated by the Variety Iron Works Company. The McClintic-Marshall Company has taken 3500 tons for a power house and blast-furnace buildings for Corrigan, McKinney & Co. at Cleveland, steel buildings for the East Jersey Pipe Company at Paterson, N. J., 525 tons, and a new building for the Union National Bank at Cleveland, Ohio, 1500 tons. We quote beams and channels up to 15 in. at 1.10c. for first quarter and 1.15c. for second quarter.

Plates.—Late in August the Cincinnati, Hamilton & Dayton Railroad placed conditionally orders for 1000 steel hopper cars with the Cambria Steel Company and 1000 box cars with the Mt. Vernon Car & Mfg. Company. The road was unable to raise the money to pay for the cars, and the order was canceled, but it has just been revived and the car companies are bidding on it again. This is the only active car inquiry in the market at this time, but there is promise of some large orders in the near future. The current demand for plates is quiet, but the outlook is better. We quote ¼-in. and heavier plates at 1.10c. for first quarter and 1.15c. for second quarter, f.o.b. Pittsburgh.

Sheets.—Some consumers of black and galvanized sheets have covered their needs for first quarter, but a few of the larger mills are not inclined to sell for more than 30 days ahead, believing that prices may shortly be higher. Mills are operating on an average of 60 to 70 per cent. We quote No. 28 Bessemer black sheets at 1.80c. to 1.85c.; No. 28 galvanized, 2.75c. to 2.80c.; Nos. 9 and 10 blue annealed, 1.30c. to 1.35c.; No. 30 black plate, tin-mill sizes, H. R. & A., 1.95c.; No. 28, 1.90c.; Nos. 27, 26 and 25, 1.85c.; Nos. 22 to 24, 1.80c.; Nos. 17 to 21, 1.75c.; Nos. 15 and 16, 1.70c. The above prices are for carload lots, f.o.b. at maker's mill, jobbers charging the usual advances for small lots from store.

Tin Plate.—Nearly all contracts for 1915 delivery have been placed, most of these running through the entire year. Prices ranged from $3.05 to $3.20 per box for 14 x 20 coke plates, and only to a few of the very largest consumers was the lower price shaded. We quote 14 x 20 coke plates on current orders at $3.10 to $3.20, but for a desirable specification the $3.10 price would be shaded.

Wire Rods.—Some consumers have covered their needs of wire rods for first half of 1915. The heavy demand for barb wire for foreign shipment is resulting in the rod mills running to nearly full capacity. We quote Bessemer, open-hearth and chain rods at $25, f.o.b. Pittsburgh.

Shafting.—Large contracts have been placed for first quarter and first half but at relatively low prices. For first quarter 67 to 68 per cent. was made, and on very desirable contracts a slightly higher discount. For second quarter, makers are trying to obtain a minimum of 67 per cent. We quote cold-rolled shafting at 67 to 68 per cent. off.

Railroad Spikes.—Railroads have placed some large contracts for first half delivery, and others are pending. The Pennsylvania Lines West bought 20,000 kegs, equally divided between the Jones & Laughlin Steel Company and Dilworth, Porter & Co., Ltd. The Baltimore & Ohio has bought 10,000 kegs; Wheeling & Lake Erie, 2000 kegs, and the Vandalia Line, 2000 kegs. We quote railroad spikes at $1.35 to $1.40, but one local maker is holding for $1.40. We quote small spikes at $1.45 to $1.50 in carload lots, f.o.b. Pittsburgh.

Skelp.—A local consumer bought recently 3500 to 4000 tons of skelp of various kinds for first quarter. Current demand is dull. We quote: Grooved steel skelp, 1.10c. to 1.15c.; sheared steel skelp, 1.15c. to 1.20c.; grooved iron skelp, 1.50c.; sheared iron skelp, 1.50c. to 1.60c., delivered to consumers' mills in the Pittsburgh district.

Hoops and Bands.—Some large consumers have covered their requirements of hoops and bands for first quarter and first half on the basis of 1.10c., for bands and 1.20c. to 1.25c. for hoops. We quote steel bands at 1.10c. for first quarter, with extras as per the steel bar card, and steel hoops at 1.20c. to 1.25c., f.o.b. Pittsburgh.

Wire Products.—The new demand for barb and fence wire is fairly active, but wire nails are dull. Contracts from abroad for 75,000 tons or more of barb wire are being figured on by local mills for early shipment. We quote: Wire nails, $1.50; plain annealed wire, $1.30; galvanized barb wire and fence staples, $1.90; painted barb wire, $1.55, all f.o.b. Pittsburgh, freight added to point of delivery, terms 30 days net, less 2 per cent. off for cash in 10 days. We quote steel cut nails at $1.50, f.o.b. Pittsburgh, in carload lots. We quote woven wire fencing at 73 per cent. off in carload lots, 72 on 1000-rod lots and 71 on smaller lots, all f.o.b. Pittsburgh.

Iron and Steel Bars.—Some heavy contracts for steel bars for delivery in first quarter have been placed at 1.10c., and for second quarter at 1.15c., f.o.b. Pittsburgh. All the large makers report they are rigidly adhering to these prices. Specifications against contracts from implement makers are coming in more freely. New demand for iron bars is dull and prices are weak. We quote steel bars at 1.10c. for first quarter, and common iron bars, made from part scrap, at 1.15c., f.o.b. Pittsburgh.

Merchant Steel.—New demand is dull, but it is believed will show betterment in the near future. Prices are irregular, and for small lots for prompt shipment are about as follows: Iron finished tire, ½ x 1½ in., and larger, 1.30c., base; under ½ x 1½ in., 1.45c.; planished tire, 1.50c.; channel tire, ¾ to ⅞ and 1 in., 1.80c. to 1.90c.; 1⅛ in. and larger, 1.90c.; toe calk, 1.90c. to 2c., base; flat sleigh shoe, 1.65c.; concave and convex, 1.70c.; cutter shoe, tapered or bent, 2.20c. to 2.30c.; spring steel, 1.90c. to 2c.; machinery steel, smooth finish, 1.70c.

Cold-Rolled Strip Steel.—Domestic demand is fair and some large consumers have covered for first quarter and first half of this year, but at relatively low prices. We quote cold-rolled strip steel as follows: Hard-rolled steel, 1½ in. and wider, under 0.20 carbon, sheared or natural mill edges, per 100 lb., $2.65 to $2.75 delivered.

Wrought Pipe.—Reports from all over the country as to probable consumption of pipe this year are encouraging. The present demand is quiet, but makers believe that it will soon be heavier. The LaBelle Iron Works, Steubenville, Ohio, has taken 65 miles of 4-in. line pipe for the Ponca City Gas Company of Oklahoma. Discounts on iron and steel pipe are firm.

Boiler Tubes.—Some large consumers have covered their needs in locomotive and merchant tubes for first quarter, but at low prices. Discounts are still more or less shaded.

Old Material.—The scrap market is strong, dealers not being inclined to sell, expecting higher prices, while consumers are anxious to buy. A local steel company has bought about 5000 tons of selected heavy steel scrap at $11.25 to $11.50, delivered, and another consumer, outside the Pittsburgh district, that has not bought in the open market for some time, has purchased a similar amount at about $11.50, delivered. It is reported that dealers are offering $11.50 for heavy steel scrap and are not getting it. We note a sale of 1000 tons of turnings at $7.75, delivered, and another of 500 tons at $8, delivered. The minimum on heavy steel scrap is $11.50, with dealers asking $11.75 or higher. For delivery to consumers' mills in the Pittsburgh and other consuming districts that take Pittsburgh freights, dealers quote as follows:

Heavy steel melting scrap, Steubenville, Follansbee, Brackenridge, Sharon, Monessen, Midland and Pittsburgh delivery	$11.50 to $11.75
Compressed side and end sheet scrap	10.00 to 10.25
No. 1 foundry cast	11.25 to 11.50
Bundled sheet scrap, f.o.b. consumers' mills, Pittsburgh district	8.50 to 8.75
Rerolling rails, Newark and Cambridge, Ohio, Cumberland, Md., and Franklin, Pa.	11.75 to 12.00
No. 1 railroad malleable stock	10.00 to 10.25
Railroad grate bars	8.50 to 8.75
Low phosphorus melting stock	13.25 to 13.50
Iron car axles	18.75 to 19.25
Steel car axles	13.25 to 13.75
Locomotive axles, steel	19.75 to 20.25
No. 1 busheling scrap	9.75 to 10.00
No. 2 busheling scrap	7.00 to 7.25
Machine shop turnings	7.75
Old carwheels	10.75 to 11.00
Cast-iron borings	8.25 to 8.50
*Sheet bar crop ends	11.00 to 11.25
Old iron rails	12.75 to 13.00
No. 1 railroad wrought scrap	10.75 to 11.00
Heavy steel axle turnings	8.50 to 8.75
Heavy breakable cast scrap	10.75 to 11.00

*Shipping point.

Coke.—No more contracts for blast-furnace coke have been closed. Active furnaces are covered for first half and some for all of 1915. Some contracts for foundry coke for first half have been closed. We quote standard makes of blast-furnace coke for prompt shipment at $1.50 to $1.60, and on contracts for first half and through all of 1915 at $1.75 per net ton at oven. Standard makes of 72-hr. foundry coke are held at about $2 for prompt shipment and $2.15 to $2.25 per net ton at oven on contracts. The Connellsville Courier gives the output of coke in the upper and lower Connellsville regions for the week ended December 26 as 208,130 net tons, an increase over the previous week of 9500 tons.

Chicago

CHICAGO, ILL., January 4, 1915.

Encouraged by the generally improved tone of the market, users of steel whose contracts expired with January 1 ordered out the tonnage balances to an extent rather better than had been anticipated. The past week also brought out some eleventh hour buying and contracting for first quarter in anticipation of the higher prices. A Western bridge company placed 1200 tons of shapes for stock for which it is understood to have paid under 1.05c., Pittsburgh. The market for shapes, plates and bars is now commonly accepted at 1.10c., Pittsburgh, for first quarter, but sheet prices are unimproved despite an equal display of interest on the part of consumers. For the railroads little actual business has as yet developed, but there are now in the market inquiries for two lots of 1000 cars and it is reported that the rail mill at the Soo will deliver to an Ohio road 15,000 tons of rails. The pig-iron market is showing little activity, though there remain unclosed a number of inquiries for small quantities. The tendency in scrap values is still upward, although held in check by limited buying on the part of melters.

Pig Iron.—The market has again dropped into a routine, not altogether colorless, for the placing of some business of small tonnage is noted from day to day and contract shipments are being taken well up to schedules. For the small lots of iron now in the market the Northern furnaces have fixed their price quite stiffly at $13, furnace, the producers relying strongly upon the expectation of renewed buying before the close of January. Iron from the South remains at $9.50, Birmingham, but the supplying of higher silicon grades at that price betrays the weakness of the situation. The following quotations are for iron delivered at consumers' yards, except those for Northern foundry, malleable Bessemer and basic iron, which are f.o.b. fur-

nace and do not include a switching charge averaging 50c. a ton:

Lake Superior charcoal	$15.75 to $16.75
Northern coke foundry, No. 1	13.25 to 13.75
Northern coke foundry, No. 2	13.00 to 13.25
Northern coke foundry, No. 3	12.50 to 13.00
Southern coke, No. 1 f'dry and 1 soft.	13.75 to 14.25
Southern coke, No. 2 f'dry and 2 soft.	13.50 to 13.75
Malleable Bessemer	13.00 to 13.25
Standard Bessemer	15.50
Basic	12.50 to 13.00
Low phosphorus	20.00 to 20.50
Jackson Co. and Ky. silvery, 6 per cent.	16.90 to 17.40
Jackson Co. and Ky. silvery, 8 per cent.	17.90 to 18.40
Jackson Co. and Ky. silv'y, 10 per cent.	18.90 to 19.40

Structural Material.—The Cincinnati, Hamilton & Dayton Railroad has revived its inquiry for box cars, which added to the Illinois Central inquiry for 1000 cars, aggregates a larger number of cars than has been in the market for some time. For architectural purposes lettings of structural material at Chicago last week were unimportant, except for the Willys-Overland Building, the contract for which was placed, calling for 1000 tons, the Hansell-Elcock Company to furnish the steel. Specifications for plain shapes from mill have been much better the past 10 days, a fact due in great measure to the expiration of last quarter contracts and to the general promise of better prices and business. Reflecting the advance of $1 a ton we quote for first quarter delivery for plain shapes from mill 1.289c., Chicago.

We quote for Chicago delivery of structural shapes from store 1.75c.

Rails and Track Supplies.—The Louisville & Nashville Railroad has bought about 40,000 tons of rails from the Tennessee Coal, Iron & Railroad Company and the New York Central Lines are in the market for a similar tonnage. The Pere Marquette has been receiving prices on 10,000 tons of rails, including a quotation from the Algoma Steel Company at the Canadian Soo, which mill is also reported to have sold 15,000 tons of rails for Ohio delivery. Indefinite reports indicate the probability of additional rail inquiry within the next few weeks. We quote standard railroad spikes at 1.50c. to 1.60c., base; track bolts with square nuts, 1.90c. to 2c. base, all in carload lots, Chicago; tie plates, $23.50 to $25, f.o.b. mill, net ton; standard section Bessemer rails, Chicago, 1.25c., base; open-hearth, 1.34c.; light rails, 25 to 45 lb., 1.07c.; 16 to 20 lb., 1.12c.; 12 lb., 1.17c.; 8 lb., 1.22c.; angle bars, 1.50c., Chicago.

Plates.—The Des Moines Bridge & Iron Company has taken an order for 1200 tons of plates for the Government for Pacific coast delivery. Covering for first quarter has been limited closely to boiler and tank makers and the miscellaneous users of plates; reports that carbuilders have participated to a considerable extent lack confirmation. Mill prices have been advanced and we quote for Chicago delivery 1.289c.

We quote for Chicago delivery of plates out of stock 1.75c.

Sheets.—Despite a fairly active display of interest on the part of sheet users regarding their first quarter needs sheet prices have failed to show improvement. We quote for Chicago delivery from mill: No. 10 blue annealed, 1.489c.; No. 28 black, 1.989c.; No. 28 galvanized, 2.889c. to 2.939c.

We quote for Chicago delivery from jobbers' stocks as follows, minimum prices applying on bundles of 25 or more: No. 10 blue annealed, 1.95c.; No. 28 black, 2.55c.; No. 28 galvanized, 3.55c.

Bars.—The implement manufacturers, although at the hight of their manufacturing season, are taking but limited tonnages of bars, their bar purchases being proportioned to the decidedly subnormal volume of implement orders. An improvement in the demand for reinforcing bars is noted. Bar-iron prices are moving upward and the general average of the market is back again to the basis of 1c. We quote for mill shipments as follows. Bar iron, 0.97½c. to 1.02½c.; soft steel bars, 1.289c.; hard steel bars, 1.20c.; shafting in carloads, 65 per cent. off; less than carloads, 60 per cent. off.

We quote store prices for Chicago delivery: Soft steel bars, 1.65c.; bar iron, 1.65c.; reinforcing bars, 1.65c. base, with 5c. extra for twisting in sizes ½ in. and over and usual card extras for smaller sizes; shafting 60 per cent. off.

Rivets and Bolts.—A number of railroad contracts which give promise of early closing are noted. We continue to quote: Carriage bolts up to ⅝ x 6 in., rolled thread, 85; cut thread, 80-20; larger sizes, 80; machine bolts up to ¾ x 4 in., rolled thread, 85-5; cut thread, 85; larger sizes, 80-5; coach screws, 85-10; hot pressed nuts, square head, $6.60 off per cwt.; hexagon, $7.60 off per cwt. Structural rivets, ¾ to 1¼ in., 1.58c., base, Chicago, in carload lots; boiler rivets, 10c. additional.

Nominally we quote out of store: Structural rivets, 2.20c.; boiler rivets, 2.30c.; machine bolts up to ¾ x 4 in., 75-15; larger sizes, 70-10-10; carriage bolts up to ⅜ x 6 in., 75-10; larger sizes, 70-15 off; hot pressed nuts, square head, $6, and hexagon, $6.70 off per cwt.

Wire Products.—The dealers supplying rural communities are building up their stocks but slowly this season and wire products are retarded in their movement in company with other agricultural supplies. We quote to jobbers as follows: Plain wire, No. 9 and coarser, base, $1.489; wire nails, $1.689; painted barb wire, $1.689; galvanized, $2.089; polished staples, $1.689; galvanized, $2.089, all Chicago.

Cast Iron Pipe.—At Cincinnati, Ohio, the United States Cast Iron Pipe & Foundry Company took 2400 tons of 36-in. pipe and on January 6 that city will buy an additional 1000 tons. We quote as follows, per net ton, Chicago: Water pipe, 4 in., $25.50; 6 to 12 in., $23.50; 16 in. and up, $23, with $1 extra for gas pipe.

Old Material.—Scrap prices continue to be supported by a market which manifests sufficient strength to maintain the upward tendency. Although consumers of scrap are not buying freely, there is sufficient demand to be felt. Incoming supplies of scrap show evidence of the temporary withholding of old material by some of the railroads, which fact adds a further strengthening influence. Railroad offerings this week from the Alton, Pennsylvania, Rock Island and Santa Fe aggregate 10,000 tons. We quote for delivery at buyers' works, Chicago and vicinity, all freight and transfer charges paid, as follows:

Per Gross Ton	
Old iron rails	$11.25 to $11.50
Old steel rails, rerolling	9.50 to 10.00
Old steel rails, less than 3 ft.	9.75 to 10.00
Old carwheels	9.75 to 10.25
Heavy melting steel scrap	9.00 to 9.25
Frogs, switches and guards, cut apart	9.00 to 9.25
Shoveling steel	8.50 to 8.75
Steel axle turnings	6.75 to 7.00

Per Net Ton	
Iron angles and splice bars	$11.00 to $11.50
Iron arch bars and transoms	11.00 to 11.50
Steel angle bars	8.25 to 8.50
Iron car axles	14.00 to 14.25
Steel car axles	10.75 to 11.25
No. 1 railroad wrought	8.25 to 8.75
No. 2 railroad wrought	7.75 to 8.25
Cut forge	7.75 to 8.25
Steel knuckles and couplers	8.25 to 8.50
Steel springs	9.25 to 9.75
Locomotive tires, smooth	8.50 to 9.00
Machine shop turnings	5.25 to 5.50
Cast borings	4.50 to 5.00
No. 1 busheling	7.50 to 7.75
No. 2 busheling	6.25 to 6.50
No. 1 boilers, cut to sheets and rings	5.25 to 5.75
Boiler punchings	8.00 to 8.25
No. 1 cast scrap	9.25 to 9.50
Stove plate and light cast scrap	8.25 to 8.50
Grate bars	8.00 to 8.25
Railroad malleable	8.00 to 8.25
Agricultural malleable	7.25 to 7.50
Pipes and flues	6.50 to 7.00

Philadelphia

PHILADELPHIA, PA., January 5, 1915.

Excellent business in steel products, particularly track supplies which the railroads are known to need, have been booked following the better demand which developed in late December. The announcement that 1.25c., Philadelphia, would be the minimum on plates, shapes and bars after December 31 caused many consumers, other than the railroads, to come forward also for miscellaneous steel products. The diversity of the orders was pleasing to steel makers, who would have booked more business were it not for the propensity of consumers to hold off in buying until satisfied that the higher level is firmly established. At present this appears to be the case, as instances are coming to light where business offered at less than the basis of 1.10c., Pittsburgh, has been refused. Structural material makes a poor showing as compared with plates and

bars. In billets and sheets there has been little or no encouragement. Though many of the details incidental to export trade are now on a satisfactory basis, there is no assurance as to when or where cargo space can be obtained and the guarantee of deliveries is, therefore, almost impossible and business suffers. The pig-iron trade, as a whole, has had a quiet week though orders for a few thousand tons were placed, including 2500 tons of basic. Old material which ordinarily would come to this district is being shipped outside, where a higher price can be realized.

Iron Ore.—The market is at a standstill. In the week ended January 2 6400 tons arrived here from Cuba. Since that time 6000 tons of Chilean ore arrived from Cruz Grande.

Pig Iron.—The market has been quiet despite the placing of a few rather good orders among which may be mentioned the taking of 2500 tons of basic by an Eastern steel company at a price reported to be $13.50, delivered. The interest making this sale also disposed of about 2500 tons of low grade iron. Other purchasing embraced approximately 2000 tons of low phosphorus taken by various consumers. A New Jersey steel company took 500 tons. It is understood that inquiries for a fair quantity of low phosphorus, both Lebanon and standard, are out. Southern and Virginia irons present nothing to report except that deliveries of the latter have been lessened at the request of melters, making it evident that improved activity has not yet reached the foundries of this territory. A few inquiries for special foundry iron in varying quantities up to 500 tons are still before the trade. Local pipe makers are looking for cheap iron. Quotations for standard brands for early delivery in buyers' yards in this district are as follows:

Eastern Penna. No. 2 X foundry	$14.25 to $14.50
Eastern Penna. No. 2 plain	14.00 to 14.25
Virginia No. 2 X foundry	15.25
Virginia No. 2 plain	15.00
Gray forge	13.50 to 13.75
Basic	13.50 to 14.00
Standard low phosphorus	20.00 to 21.00

Ferroalloys.—Interest in ferromanganese appears to be more or less dormant, despite the peculiar situation which exists. The only business reported concerns a few small sales made recently for forward delivery at $68, Baltimore, for 80 per cent. material. Whether delivery can be made now or in the future seems problematical. Some advices from abroad assert that none can be shipped, but others say that shipment from England is contingent on a license being obtained from the British government, while consumers must pledge themselves in writing not to reship the ferromanganese and also not to ship their products to Germany, Austria or Turkey. Where they ship to the allies or neutral countries it must be done through London. No change is reported in 50 per cent. ferrosilicon, which is quoted at $71 to $73, Pittsburgh.

Bars.—As was expected, a large tonnage of steel bars was booked in the closing days of 1914, when prompt business was taken at 1.20c., Philadelphia. The demand for merchant bars has been especially good, indicating a widespread tendency to replenish stocks. One local producer booked an order for 5000 tons. The Pennsylvania Railroad and the Baltimore & Ohio Railroad are in the market for bars. The demand for iron bars shows a little improvement, with the quotation unchanged at 1.17½c., Philadelphia.

Plates.—Makers are firmly holding 1.25c., Philadelphia, for first quarter business and asking 1.30c. for second quarter in which a limited business is being done. Specifications have run into good figures and one mill ran steadily all last week, ignoring the New Year holiday. The A. H. Bull Steamship Company has placed an order for the construction of a 340-ft. cargo steamship with the Maryland Steel Company, which will obtain the plates and shapes required from the Cambria Steel Company.

Structural Material.—The market continues unsatisfactory in view of the lack of building in this territory, which can scarcely improve in the next few months in view of the time required to initiate projects, prepare plans, etc. The largest inquiry before the market is that of the Pennsylvania Railroad for several thousand tons of bridge materials for its 1915 needs. The contract for 300 tons of steel for the power house of William H. Grundy & Co., Philadelphia, Heacock & Hokanson, architects, has been awarded to Robert B. Lederle, Philadelphia. The quotation for first quarter delivery is 1.25c., Philadelphia.

Sheets.—The request for sheets drags in a disappointing way. Makers feel that they are entitled to a better price than 1.45c., Philadelphia, for No. 10 blue annealed, but not enough life is shown by the market to warrant an advance.

Billets.—The demand continues at low ebb and one eastern Pennsylvania mill will not resume operations until about January 11, when it will be started in part only. The quotation for open-hearth rolling billets delivered here is unchanged at $21.40, with forging steel running about $4 higher.

Coke.—Interest in the placing of contracts for furnace coke has largely subsided. Those recently placed approximate in size those of last year, although present consumption is cut down by the fewer furnaces in blast. Foundry coke is moving slowly. The quotation for first half contract standard Connellsville furnace coke is about $1.75 per net ton at oven. Prompt foundry is quoted at $2 to $2.25 per net ton at oven and $2.35 to $2.50 on contract. Freight rates from the principal producing districts are as follows: Connellsville, $2.05; Latrobe, $1.85, and Mountain, $1.65.

Old Material.—Little disposition to buy is shown here, but prices of some materials have been advanced in keeping with the higher prices obtainable elsewhere, notably Pittsburgh. The conditions are such that material which ordinarily comes here from other sections is being sent to Pittsburgh and mills in this vicinity can only get local scrap. Greater strength is predicted for the market. Quotations for delivery in buyers' yards in this district, covering eastern Pennsylvania and taking freight rates from 35c. to $1.35 per gross ton, are as follows:

No. 1 heavy melting steel	$10.00 to $10.50
Old steel rails, rerolling	10.50 to 11.00
Low phosphorus heavy melting steel scrap	14.00 to 14.50
Old steel axles	13.00 to 13.50
Old iron axles	17.50 to 18.00
Old iron rails	13.00 to 14.00
Old carwheels	11.00 to 11.50
No. 1 railroad wrought	12.00 to 12.50
Wrought-iron pipe	9.50 to 10.00
No. 1 forge-fire	8.00 to 8.50
Bundled sheets	8.00 to 8.50
No. 2 busheling	7.75 to 8.25
Machine shop turnings	8.00 to 8.50
Cast borings	8.00 to 8.50
No. 1 cast	12.00 to 12.50
Grate bars, railroad	8.00 to 8.50
Stove plate	8.00 to 8.50
Railroad malleable	9.00 to 9.50

Cleveland

CLEVELAND, OHIO, January 4, 1915.

Pig Iron.—The market has again quieted down and business during the week was limited to a few sales of small lots. Outside of this immediate territory the sale of 3000 tons of foundry iron is reported to have been made to a western Pennsylvania consumer. There is practically no new inquiry. Most consumers in this territory are now either covered with contracts for first quarter or have enough iron to last them for some time so that sellers expect little activity in January. Many consumers held up shipments during the holiday season, but shipping orders are again coming in. Quotations are unchanged at $12.75 to $13, Cleveland, for outside shipments. There is little inquiry for Southern iron, which is generally quoted at $10, Birmingham, for No. 2, with some iron still to be had at $9.50. During the recent buying movement there was little activity in Ohio silvery iron. Prices on this iron are not firm although quotations are unchanged. We quote, delivered Cleveland, as follows:

Bessemer	$14.70
Basic	13.45
Northern No. 2 foundry	13.25 to 13.50
Southern No. 2 foundry	13.50 to 14.00
Gray forge	13.00
Jackson Co. silvery 8 per cent. silicon	17.62
Standard low phos., Valley furnace	20.00 to 20.25

Iron Ore.—Furnace companies are as yet showing no interest in the market and sellers who thought that possibly a buying movement would start by February 1 do not now look for any activity before March. We quote prices as follows: Old range Bessemer, $3.75; Mesaba Bessemer, $3.50; old range non-Bessemer, $3; Mesaba non-Bessemer, $2.85.

Coke.—Many consumers of foundry coke who covered only for their last half requirements have enough coke coming on their contracts to last them several weeks and have not yet come in the market for first half. The demand for foundry grades is light and there is no activity in furnace coke. We quote standard makes of Connellsville foundry coke at $2.25 to $2.50, per net ton at oven, for prompt shipment and contract. The sale of 10 cars of Virginia coke is reported at $2.40. Furnace coke is held at $1.50 to $1.60 for prompt shipment and $1.75 for contracts.

Finished Iron and Steel.—The general advance in prices on steel bars, plates and structural material to 1.10c., Pittsburgh, had the effect of bringing out a rush of current orders at 1.05c., during the last day or two of the year. Since then the market has been stagnant so that it cannot be determined as yet whether the new prices will hold. Some of the smaller plate mills have not yet fallen in line with the advance made by the larger mills but show indications of stiffening up. The advance also had the effect of bringing out some first quarter contracts from consumers who had been holding off with the hope of getting 1.05c. and also stiffening up the second quarter prices on steel bars to 1.15c. Before the advance some consumers outside of the implement trade were able to secure steel-bar contracts for the second quarter at 1.10c. Activity in structural material has improved. The McClintic-Marshall Company has taken 3500 tons and the Variety Iron & Steel Works Company 1100 tons for work in connection with the new Corrigan, McKinney & Co. blast furnaces in Cleveland, and the McClintic-Marshall Company has taken 1200 tons for the Union National Bank Building, Cleveland, and 700 tons will be placed for the Empire Rolling Mills Company building in a day or two. Plans are out for the Jewish Hospital in Cleveland, requiring a round tonnage, and among new building projects is the Northern National Bank in Toledo. Sheets are quiet, most consumers now being under contract. Prices are well maintained at 1.80c. for No. 28 black; 2.80c. for No. 28 galvanized, and 1.35c. for No. 10 blue annealed for spot shipment and contract. Iron bars are quiet with the usual quotation of 1.20c. for Cleveland delivery. Warehouse prices are 1.80c. for steel bars and 1.90c. for plates and structural material.

Bolts, Nuts and Rivets.—The bolt and nut market is again very dull, but some revival of activity is expected after consumers complete their inventories. Prices both for prompt shipment business and contracts are weak and irregular, not yet having been effected by the advance in steel prices. Rivets are being fairly well maintained at 1.40c. for structural and 1.45c. for boiler rivets, for carload lots for prompt shipment and for the first quarter. Discounts are as follows: Common carriage bolts ⅜ x 6 in., smaller or shorter, rolled thread, 80 and 10 and 5 per cent.; cut thread, 80 and 10 per cent.; larger or longer, 75 and 15 per cent.; machine bolts with h. p. nuts, ⅜ x 4 in., smaller or shorter, rolled thread, 80 and 10 and 10 per cent.; cut thread, 80 and 10 and 5 per cent.; larger or longer, 80 per cent.; coach and lag screws, 80 and 5 per cent.; square h. p. nuts, blank or tapped, $6.50 off; hexagon h. p. nuts, blank or tapped, $7.40 off; c. p. c. and t. square nuts, blank or tapped, $6.20 off; hexagon, ⅝ in. and larger, $7.50 off; 9/16 in. and smaller, $8 off; semi-finished hexagon nuts, ⅝ in. and larger, 85, 10 and 10 per cent., 9/16 in. and smaller, 85, 10, 10 and 10 per cent.

Old Material.—The market is dull but slightly firmer. Dealers are not inclined to make sacrifice sales and some are waiting for better prices. Dealers have advanced prices 25c. a ton on heavy steel scrap, turnings, borings, railroad wrought and railroad malleable. In the Valley heavy steel is still quoted at $10.50 to $10.75, but consumers are under contract and there is no new demand. The Baltimore & Ohio Railroad will close on a large list January 11. Bids will be taken on the two Pennsylvania lists January 8. We quote, f.o.b. Cleveland, as folows:

Per Gross Ton

Old steel rails, rerolling	$11.00 to $11.75
Old iron rails	12.00
Steel car axles	12.25 to 12.75
Heavy melting steel	9.25 to 9.75
Old carwheels	10.00 to 10.50
Relaying rails, 50 lb. and over	23.00 to 25.00
Agricultural malleable	8.00 to 8.50
Railroad malleable	9.50 to 9.75
Light bundled sheet scrap	7.50 to 8.00

Per Net Ton

Iron car axles	$16.00 to $16.50
Cast borings	5.75 to 6.00
Iron and steel turnings and drillings	5.25 to 5.50
Steel axle turnings	6.00 to 6.25
No. 1 busheling, new	8.00 to 8.50
No. 1 busheling, old	8.00 to 8.25
No. 1 railroad wrought	9.25 o 9.75
No. 1 cast	10.00 to 10.50
Stove plate	7.50

Cincinnati

CINCINNATI, OHIO, January 5, 1915.—(*By Wire.*)

Pig Iron.—Several new general inquiries have come out, the largest of which is for 1500 tons of malleable for an Indiana manufacturer. A southern Indiana firm expects to buy soon 300 tons of Southern foundry for first half and several deals for larger tonnages are yet unclosed that are expected to be consummated this week. The low prices prevailing lately have not stimulated much speculative buying, and practically all contracts are for the closely estimated first half needs of melters. Shipments on old contracts are moving at a more satisfactory rate in spite of the usual dull holiday period. Some Southern iron is still obtainable at $9.50, Birmingham, for first half, while Northern prices range from $12.75 to $13, Ironton. The silvery irons are quiet. Production in the Hanging Rock district has been increased by the blowing in of the big Etna furnace last week. Based on freight rates of $2.90 from Birmingham and $1.26 from Ironton, we quote, f.o.b. Cincinnati, as follows:

Southern coke, No. 1 f'dry and 1 soft.	$12.90 to $13.40
Southern coke, No. 2 f'dry and 2 soft.	12.40 to 12.90
Southern coke, No. 3 foundry	11.90 to 12.40
Southern No. 4 foundry	11.40 to 11.90
Southern gray forge	10.90 to 11.40
Ohio silvery, 8 per cent. silicon	17.20 to 17.70
Southern Ohio coke, No. 1	15.01 to 15.51
Southern Ohio coke, No. 2	14.01 to 14.51
Southern Ohio coke, No. 3	13.76 to 14.01
Southern Ohio malleable Bessemer	14.26
Basic, Northern	14.51 to 15.01
Lake Superior charcoal	15.25 to 17.25
Standard Southern carwheel	26.90 to 27.40

Coke.—The market is very dull, although shipments to foundries are moving along at a fairly satisfactory pace. Prices are unchanged.

Finished Iron and Steel.—The inquiry for sheets has improved but nearby mills are not willing to quote present market prices for delivery beyond January 31. Other products are quiet.

Old Material.—Dealers are more optimistic. While some heavy buying of steel scrap is reported in other markets, transactions here have been mostly of small lots of cast needed by the jobbing and stove foundries. Quotations are unchanged. The minimum figures given below represent what buyers are willing to pay for delivery in their yards, southern Ohio and Cincinnati, and the maximum quotations are dealers' prices, f.o.b. at yards:

Per Gross Ton

Bundled sheet scrap	$6.25 to $6.75
Old iron rails	11.00 to 12.00
Relaying rails, 50 lb. and up	19.75 to 20.25
Rerolling steel rails	9.75 to 10.25
Melting steel rails	8.75 to 9.25
Heavy melting steel scrap	8.50 to 9.00

Per Net Ton

No. 1 railroad wrought	$7.50 to $8.00
Cast borings	4.00 to 4.50
Steel turnings	4.00 to 4.50
Railroad cast scrap	9.25 to 9.75
No. 1 machinery cast scrap	9.75 to 10.25
Burnt scrap	6.00 to 6.50
Old iron axles	13.50 to 14.00
Locomotive tires (smooth inside)	8.75 to 9.25
Pipes and flues	5.50 to 6.00
Malleable and steel scrap	6.75 to 7.25
Railroad tank and sheet scrap	4.50 to 5.00

St. Louis

ST. LOUIS, MO., January 4, 1915.

Pig Iron.—Several inquiries are still pending, including 600 tons of Lake Superior charcoal carwheel iron, 500 tons of Northern coke carwheel iron, 1100 tons of foundry grades and 1200 tons of malleable. One sale is reported of 2000 tons and one of about 1100 tons. The aggregate for the week was possibly 6000 tons. Representatives of furnaces say that the year's bookings are close to those of 1913. There have been some reports of prices below $9.50, Birmingham, for No. 2 Southern foundry, but so far sales have been of iron grading between No. 3 and No. 2.

Coke.—A 12,000-ton inquiry for furnace coke for smelter use is pending, but the buyer is reported to be in no immediate need. Prices continue at about the level of other markets, and by-product coke is quoted on a parity with Connellsville coke plus the freight rate of $2.80 per ton.

Finished Iron and Steel.—The principal interest reports that the year has closed with a tonnage in excess of 1913 and the money value also in excess, this having been effected by good sales at good prices early in the year. Demand for current use is increasing. The railroads have closed a number of contracts for track fastenings, and light rails have shown slightly better tendencies. Warehouse business continues good and the movement out of stock is generous. Quotations for material in warehouse are as follows: Soft steel bars, 1.70c.; iron bars, 1.65c.; structural material, 1.80c.; tank plate, 1.80c.; No. 10 blue annealed sheets, 2c.; No. 28 black sheets, cold rolled, 2.55c.; No. 28 galvanized sheets, black sheet gauge, 3.55c.

Old Material.—The scrap dealers are encouraged by increased inquiry from the steel mills, although the railroads continue to push out large quantities of old material. Prices are firm. The lists out include 1800 tons from the Missouri Pacific. We quote dealers' prices, f.o.b. St. Louis, as follows:

Per Gross Ton.

Old iron rails	$10.00 to $10.25
Old steel rails, re-rolling	10.00 to 10.25
Old steel rails, less than 3 feet	10.00 to 10.25
Relaying rails, standard section, subject to inspection	21.00 to 23.00
Old car wheels	10.25 to 10.50
No. 1 railroad heavy melting steel scrap	9.50 to 9.75
Shoveling steel	8.75 to 9.00
Frogs, switches and guards cut apart	9.50 to 9.75
Bundled sheet scrap	5.50 to 6.00

Per Net Ton.

Iron fish plates	$10.50 to $10.75
Steel angle bars	8.75 to 9.00
Iron car axles	15.00 to 15.50
Steel car axles	10.75 to 11.00
Wrought arch bars and transoms	10.75 to 11.25
No. 1 railroad wrought	8.00 to 8.25
No 2 railroad wrought	7.75 to 8.00
Railroad springs	8.75 to 9.00
Steel couplers and knuckles	8.75 to 9.00
Locomotive tires, 42" and over, smooth	8.75 to 9.00
No. 1 dealers' forge	7.25 to 7.50
Mixed borings	5.00 to 5.25
No. 1 busheling	7.50 to 7.75
No. 1 boilers, cut to sheets and rings	5.50 to 6.00
No. 1 railroad cast scrap	9.50 to 10.00
Stove plate and light cast scrap	7.50 to 8.00
Railroad malleable	7.25 to 7.50
Agricultural malleable	6.50 to 6.75
Pipes and flues	6.00 to 6.25
Railroad sheet and tank scrap	6.00 to 6.25
Railroad grate bars	7.25 to 7.50
Machine shop turnings	5.75 to 6.00

Birmingham

BIRMINGHAM, ALA., January 4, 1914.

Pig Iron.—A most careful estimate of the pig-iron sales made by Birmingham district operators during the past buying movement places the total around 300,000 to 350,000 tons, the bulk of this business calling for delivery in first half. Against these sales there are stocks well balancing them. The result is that the year starts without special optimistic aspects, the tonnage sold constituting only a two-months' make. Still, the furnacemen declare the ice is broken and are inclined to look for gradual betterment. Foundry operations have somewhat increased, especially with the water and gas pipe manufacturers, Southern iron consumption being thus accentuated to an extent. Cotton movements have begun in earnest and will constitute a rejuvenating factor. The result of the heavy sales of pig iron has been a stronger inclination to advance to the $10 level, and that is believed to be the price in some quarters, but it remains that large tonnages can still be had at $9.50, for competitive territory at least, while $9.75 appears to be the usual price obtained for small lots. Several furnaces are ready for the torch, but there does not appear to be a disposition to increase output at this time. The local consumption of basic iron in January will be larger than for some time, the steel mills of the Tennessee Company at Ensley having begun a second week's turn in all departments. There is less heard of hold-up shipments than in some time. We quote, per gross ton, f.o.b. Birmingham furnaces, as follows:

No. 1 foundry and soft	$10.00 to $10.25
No. 2 foundry and soft	9.50 to 9.75
No. 3 foundry	9.00 to 9.25
No. 4 foundry	8.75 to 9.00
Gray forge	8.50 to 8.75
Basic	9.50 to 10.00
Charcoal	22.50 to 23.00

Cast-Iron Pipe.—Birmingham district foundries seem to have acquired a considerable portion of recent lettings. Many estimates have been recently submitted, the majority of the contracts coming from the West, while some business has also been taken for the East. In some instances bids were not submitted on Eastern offerings, owing to prohibitive freight rates. Sanitary pipe continues rather dull. We quote per net ton, f.o.b. pipe shop yards, as follows: 4-in., $20; 6-in. and upward, $18, with $1 added for gas pipe.

Coal and Coke.—The demand for coke has shown some improvement, owing to the season, many foundries being in the market for three to six months' supply and sales will be considerable for some time. Prevailing prices, per net ton, f.o.b. oven, are as follows: Furnace coke, $2.75 to $2.90; foundry, $3.20 to $3.40. Colder weather has stimulated the domestic market and that in turn has reflected beneficially on the steam coal business. Mines, as a rule, however, continue to operate on a 50 per cent. basis.

Old Material.—The scrap market has shown a distinctly better tone, but no such volume of business has been transacted as to indicate anything for the future. The greater demand has been for steel scrap. We quote, per net ton, f.o.b. dealers' yards, as follows:

Old iron axles	$13.00 to $13.50
Old steel axles	12.50 to 13.00
Old iron rails	12.00 to 12.50
No. 1 railroad wrought	8.50 to 9.00
No. 2 railroad wrought	7.50 to 8.00
No. 1 country wrought	8.00 to 8.50
No. 2 country wrought	7.00 to 7.50
No. 1 machinery cast	9.50 to 10.00
No. 1 steel scrap	8.00 to 8.50
Tram carwheels	8.50 to 9.00
Stove plate	8.00 to 8.50

San Francisco

SAN FRANCISCO, CAL., December 29, 1914.

Merchants and manufacturers are still holding off, and seem much in doubt as to their policy for the near future. The announcement of an advance of about $1 per ton in the Panama Canal freight rate on most steel products is expected to have little effect on the situation.

Bars.—Aside from one good contract the movement of reinforcing bars is light, and little desirable business is in prospect. Competition is keen between Eastern and local mills, and the latter are running in a very small way, though the advanced freight rate may help them somewhat. Prices for shipments from mills are held on the basis of about 1.10c., Pittsburgh.

Structural Material.—A few small contracts have been taken by local fabricators. More plans are now being drawn, and money for building is more easily available. The city of Sacramento has ordered plans for a hall of justice to cost $225,000. Business in plain material is pretty closely limited to specifications on contracts.

Plates.—The Navy Yard oil-tank contract, for about 1100 tons, has been placed with an Eastern concern. The Willamette Iron & Steel Company has the Oregon City pipe line contract, requiring about 3000 tons of plates, and a few smaller riveted pipe con-

tracts have lately been placed. General jobbing business is dull.

Sheets.—Some first-quarter contracts have been placed, but the trade is evidently not yet ready to take hold in a large way. Requirements in the building trade have dropped off considerably. Prices have developed further easiness, No. 28 galvanized being commonly quoted at 2.75c., Pittsburgh, with offerings reported at 2.70c. or even lower.

Standard Pipe.—Trade is exceptionally dull. Some acceleration in the general consuming demand is expected within the next month or two, but merchants have not yet started to build up their stocks.

Cast-Iron Pipe.—No inquiries worth mentioning have appeared in this vicinity. A little more activity is noted, however, in Oregon and Washington, where several small orders have been placed.

Pig Iron.—Foundry business in all lines is exceptionally quiet, and melters are quite liberally supplied with iron. It is accordingly difficult to arouse any interest in offerings of any description and values are too uncertain to warrant quotations. Melters are getting correspondence from numerous Southern and Eastern furnace interests, but can give little attention to such offerings under present conditions.

Coke.—Some further small quantities of foreign coke have arrived. Consumers are heavily supplied, and with practically no demand spot values are entirely nominal. Efforts are being made to dispose of a cargo of English coke to arrive about midsummer, which is offered at about $12 per gross ton.

Old Material.—Business is extremely quiet, as requirements are small and the larger consumers are well covered. No interest is taken in steel melting scrap, and some effort to sell by dealers is noted. It is still nominally valued at about $5 to $8 per gross ton. Small sales of cast-iron scrap are being made at $14 to $16 per net ton.

New York

NEW YORK, January 5, 1915.

Pig Iron.—An inquiry for 450 tons for the Lackawanna Railroad's foundry at Scranton, Pa., is the largest that has come out in the Eastern market. A number of foundries that did not take part in the November buying will need metal in the next two months, and a fair running business is looked for, as the outlook for work for machinery foundries is generally better. In New England, apart from malleable lines, the indications in jobbing lines are better. We quote Northern iron for tidewater delivery as follows: No. 1 foundry, $14.45 to $14.95; No. 2 X, $14.20 to $14.45; No. 2 plain, $13.95 to $14.20. Southern iron is nominally $14.50 for No 1 and $14 to $14.25 for No. 2.

Ferroalloys.—No change is reported in the embargo situation on ferromanganese. No shipments have been made nor has any word been received as to when any may be expected. Representatives here of English producers have complied fully with all the original requirements, one going so far as to prepare a special form to be filled out by consumers. No anxiety is apparent among users since most are well covered for several months. The feeling prevails that a solution will ultimately be arrived at satisfactory to all concerned since such an outcome is for the best interests of English producers in their future relations with the market here. Quotations continue at $68, seaboard, when deliveries can be made. Inquiries are fair, 300 tons being the largest before the market. Ferrosilicon, 50 per cent., is still quoted at $71 to $73, Pittsburgh, with normal demands the rule.

Finished Iron and Steel.—The dulling effect of the holidays is still apparent. General sentiment is strong that as soon as the trade recovers from the let-down due to the vacation and inventory period, a marked activity in nearly all lines will be apparent. A better year is generally looked for. Structural inquiries or lettings are scarce. The Dover Boiler Works has been awarded the contract for school No. 18, Brooklyn, 300 tons, F. L. Heughes & Co. have 225 tons for the Iola Sanitarium, Rochester, and several hundred tons will likely soon be placed for the Bowery Y. M. C. A. building. A new large project being figured is a 12-story mercantile building, requiring 1200 tons, for the Murray Hill Investment Company, Fifth avenue and Thirty-seventh street. Railroad buying is still slow to appear, but the 6-mo. requirements of the New York Central are being figured in track accessories, and the Lake Superior & Ishpeming has entered the market for 400 ore cars. It is understood that the Union Tank Line has closed for the 500 additional tank cars with the Standard Steel Car Company. We quote mill shipments of steel bars, shapes and plates at 1.10c to 1.15c., Pittsburgh, or 1.26c. to 1.31c., New York, and iron bars at 1.20c. to 1.25c., New York. From store we quote iron and steel bars at 1.80c. to 1.85c., New York, and plates and shapes at 1.85c. to 1.90c.

Cast-Iron Pipe.—No new municipal lettings of consequence are announced, but pipe manufacturers are encouraged by the continuous stream of orders from private buyers. This is imparting much more life to the trade than has been the case for a long time. These buyers are quite frequently placing orders for larger quantities than has been their practice. Conditions look promising for a considerably larger volume of business in 1915 than in the year just ended. Prices have not yet shown an advance, and quotations on carload lots of 6-in. are unchanged at $20 to $20.50 per net ton, tidewater, New York.

Old Material.—While the general feeling continues to grow more confident, this market has shown decided apathy among consumers. Other iron centers are displaying more strength in old material prices, and dealers here are unwilling to sell at rates recently ruling, but in the absence of actual business quotations are wholly nominal, as follows, per gross ton, New York:

Old girder and T rails for melting	$7.25 to	$7.50
Heavy melting steel scrap	7.25 to	7.50
Relaying rails	19.00 to	19.50
Rerolling rails (nominal)	8.00 to	8.25
Iron car axles	14.00 to	14.25
Steel car axles	10.25 to	10.75
No. 1 railroad wrought	8.75 to	9.25
Wrought-iron track scrap	8.25 to	8.75
No. 1 yard wrought, long	8.25 to	8.75
No. 1 yard wrought, short	7.25 to	7.50
Light iron	3.50 to	4.00
Cast borings	5.50 to	6.00
Wrought turnings	5.50 to	6.00
Wrought pipe	7.00 to	7.25
Carwheels	8.75 to	9.25
No. 1 heavy cast, broken up	9.75 to	10.25
Stove plate	7.50 to	8.00
Locomotive grate bars	6.25 to	6.75
Malleable cast	7.00 to	7.50

British Market Maintains Strength

No Ferromanganese Developments—Steel Firm —Full Employment for Available Labor

(*By Cable*)

LONDON, ENGLAND, January 5, 1915.

Cleveland pig-iron stocks are increasing slightly, with shipments interrupted from the Tees. Scotch pig-iron shipments last year decreased 62,000 tons; Cumberland, 55,000 tons; Cleveland, 304,000 tons. Furnaces in blast in the three districts are 161, against 164 last year. Stocks of pig iron in Connal's stores are 110,183 tons, against 103,502 tons last week. Finished and semi-finished steel are firm, with full employment for the limited labor forces available. The tin-plate export prohibition is practically removed as regards Sweden, satisfactory guarantees having been arranged by the Swedish Government. Ferromanganese is nominal. We quote as follows:

Tin plates, coke 14 x 20, 112 sheets, 108 lb., f.o.b. Wales, 12s. 7½d. ($3.07).

Cleveland pig-iron warrants 55s. ($13.39).

No. 3 Cleveland pig iron, makers' price, f.o.b. Middlesbrough, 55s. 6d. ($13.51).

Steel black sheets, No. 28, export, f.o.b. Liverpool, £8 17s. 6d. ($43.19).

Steel ship plates, Scotch, delivered local yards, £7 5s. ($35.28).

Steel rails, export, f.o.b. works port, £6 7s. 6d. ($31.02).

Hematite pig iron, f.o.b. Tees, 72s. 6d. ($17.64).

Sheet bars (Welsh), delivered at works in Swansea Valley, 100s. ($24.33).

Steel joists, 15 in., export, f.o.b. Hull or Grimsby, £6 17s. 6d. ($31.02).

Steel bars, export, f.o.b. Clyde, £7 5s. ($13.28).

Boston

BOSTON, MASS., January 5, 1915.

Old Material.—Melting steel scrap has advanced somewhat sharply in the last few days, influenced by the Pittsburgh market. Dealers here believe that eastern Pennsylvania will soon respond to the renewed activity in the Pittsburgh district. Local demand is better. Boston dealers are pleased with the beginning of 1915. They have been hopeful for some weeks and now they are commencing to get tangible results. Their optimism is accentuated by the practically unanimous opinion of men in metal trades that the curve of demand has started upward and will continue to delineate better business, ascending gradually, perhaps, but steadily. Prices are unchanged, except on steel. The quotations given below are based on prices offered by the large dealers to the producers and to the small dealers and collectors, per gross ton, carload lots, f.o.b. Boston and other New England points which take Boston rates from eastern Pennsylvania points. Mill prices are approximately 50c. per ton higher.

Heavy melting steel	$8.25 to $8.50
Low phosphorus steel	13.75 to 14.75
Old steel axles	12.75 to 13.25
Old iron axles	20.25 to 20.75
Mixed shafting	12.00 to 12.25
No. 1 wrought and soft steel	8.25 to 8.75
Skeleton (bundled)	5.50 to 5.75
Wrought-iron pipe	7.00 to 7.50
Cotton ties (bundled)	5.25 to 5.75
No. 2 light	3.25 to 3.75
Wrought turnings	5.00 to 5.50
Cast borings	5.00 to 5.25
Machinery cast	10.75 to 11.00
Malleable	7.50 to 7.75
Stove plate	7.00 to 7.50
Grate bars	5.25 to 5.50

Metal Market

NEW YORK, January 5, 1915.

The Week's Prices

Cents Per Pound for Early Delivery

	Copper, New York			Lead		Spelter	
Dec.	Lake	Electrolytic	Tin, New York	New York	St. Louis	New York	St. Louis
30	13.50	13.00	33.12½	3.80	3.62½	5.60	5.45
31	13.50	13.00	32.87½	3.80	3.62½	5.60	5.45
Jan.							
2	13.50	13.00	.....	3.80	3.62½	5.60	5.45
4	13.50	13.00	33.10	3.80	3.60	5.70	5.55
5	13.50	13.00	33.25	3.80	3.60	5.75	5.60

Copper is dull and quotations are nominal. Tin is unchanged in price and demand is light. Lead shows weakness. Spelter has been more active and quotations are higher. Antimony is firm at unchanged prices.

New York

Copper.—It is agreed on all sides that the week has been a most quiet one. In fact, there has been so little business in electrolytic that quoted prices are nominal. There have been reports of sales at concessions but these are unconfirmed. In Lake the activity resultant from the requirements of the ammunition makers has continued and choice brands are quoted up to 13.75c., although prime Lake can be had at 13.50c. The nominal quotation for electrolytic is 13c., cash, New York. The United States Geological Survey estimates the domestic smelter production of copper from domestic ores in 1914 at 504,018 tons as against 546,645 tons in 1913.

Copper Averages.—The average New York price for Lake copper for the month of December, based on daily quotations in *The Iron Age*, was 13.30c. and for electrolytic, 13.03c.

Tin.—End-of-the-year influences and the New Year holiday had the effect of making the market quiet in all positions. The statistics for December are the important feature. Deliveries into consumption were small, amounting to but 1900 tons, and the total for 12 months showed a decrease of 2200 tons, compared with the same time last year. Arrivals at Atlantic ports amounted to only 860 tons, deducting 240 tons exported to Russia. Of the month's deliveries 400 tons arrived at Pacific coast ports. The total deliveries in 1914 were 41,700 tons, as against 43,900 tons in 1913. At the end of the month there was in stock, including on dock and landing, 1386 tons. The total visible supply December 31, 1914, was 13,396 tons against 11,483 tons November 30 and 13,893 tons December 31, 1913. Arrivals this month total 510 tons and there is afloat 3765 tons. The opening of the London Stock Exchange had a beneficial effect on the market. The New York quotation to-day is 33.25c.

Lead.—The market has been quiet throughout the week and is weaker largely because of the figures contained in the report for 1914 of the United States Geological Survey, which shows that there was a large increase in the production in the year just ended. The production of refined, desilverized and soft lead from domestic and foreign ores is estimated at 537,079 tons in 1914, against 462,400 tons in 1913. As a result of the statistical showing and the poor demand, the St. Louis market has eased off to 3.60c., although New York is unchanged at 3.80c. Exports in November amounted to 11,354 tons.

Spelter.—The inquiry now out is reported to be the best in several weeks, both here and abroad, and the market has advanced to 5.75c., New York, and 5.60c., St. Louis. The yearly production statistics of spelter are unavailable because of the refusal of some of the producers to make any returns to the Government. The exports of spelter in the month of November amounted to 8856 tons.

Antimony.—The domestic demand continues dull, but the market is held up directly or indirectly by foreign demand. Russia has purchased all of the antimony that Japan can produce for several months to come and there is new export inquiry in this market. Quotations are unchanged at about 14.50c. to 15c. for Cookson's, 14c. to 14.50c. for Hallett's and 13c. to 13.50c. for Chinese.

Old Metals.—The market continues quiet. Dealers' selling prices are unchanged, being nominally as follows:

	Cents per lb.
Copper, heavy and crucible	12.25 to 12.50
Copper, heavy and wire	11.75 to 12.00
Copper, light and bottoms	10.75 to 11.00
Brass, heavy	9.00 to 9.25
Brass, light	7.00 to 7.25
Heavy machine composition	11.00 to 11.25
Clean brass turnings	8.25 to 8.50
Composition turnings	9.50 to 9.75
Lead, heavy	3.55
Lead, tea	3.30
Zinc, scrap	4.00

St. Louis

JANUARY 4.—Non-ferrous metals have been quiet, with prices slightly downward. Lead is quotable to-day at 3.62½c.; spelter, 5.50c. to 5.60c.; Lake copper, 13.75c.; electrolytic copper, 13.50c.; tin, 35c.; antimony, Cookson's, 16c. Zinc blende ranged from $50 to $55.50 per ton; calamine, $22 to $30, and lead ore held at $47. Miscellaneous scrap metals are quoted as follows: Light brass, 5c.; heavy yellow brass, 7c.; heavy red brass and light copper, 8c.; heavy copper and copper wire, 9c.; pewter, 20c.; tinfoil, 24c.; lead, 3c.; zinc, 3c.; tea lead, 3c.

Chicago

JANUARY 4.—The stronger technical position of copper finds response in a slight advance. The spelter market also is slightly stiffer. Scrap metal quotations are unchanged. Quotations are as follows: Casting copper, 13c. to 13.25c.; Lake copper, 13.25c. to 13.50c., for

prompt shipment; small lots, ⅛c. to ¼c. higher; pig tin, carloads, 34.50c.; small lots, 37.50c.; lead, desilverized, 3.70c. to 3.75c., and corroding, 4c., for 50-ton lots; in carloads, 2½c. per 100 lb. higher; spelter, 5.55c. to 5.60c.; sheet zinc, 8.75c.; Cookson's antimony, 18c. to 20c., for cask lots; other grades, 15c. to 16c. On old metals we quote buying prices for less than carload lots as follows: Copper wire, crucible shapes, 10.50c.; copper bottoms, 9c.; copper clips, 10c.; red brass, 9.50c.; yellow brass, 7c.; lead pipe, 3c.; zinc, 3.50c.; pewter, No. 1, 24c.; tinfoil, 28c.; block tin pipe, 30c.

Iron and Industrial Stocks

NEW YORK, January 5, 1915.

The stock market has shown increased strength, due to more encouraging business developments. Railroad stocks have been advancing as well as industrial stocks. Transactions were not large, as trading still continues somewhat restricted. The range of prices on active iron and industrial stocks from Wednesday of last week to Monday of this week are as follows:

Allis-Chal., com.....	8	Pressed St'l, com.	33⅞- 34¾
Am. Can, com...	25⅛- 26⅛	Ry. Spring, com.....	22½
Am. Can, pref...	89 - 90	Republic, com....	18½- 19
Am. Car & Fdy., com.	44½- 45	Republic, pref.....	75
Am. Loco., com..	23 - 24	Rumely Co., com.	4 - 4⅜
Bald. Loco., pref.	101 -103	Sloss, com.....	22 - 23
Beth. Steel, com.	45¼- 49	Pipe, com.....	8
Beth. Steel, pref.	89½- 92	U. S. Steel, com..	48¾- 50½
Colorado Fuel...	20½- 22	U. S. Steel, pref.	104¼-105
General Elec.....	138⅝-140½	West'gh'se Elec..	67 - 69
Gt. N. Ore Cert..	25¼- 27	Chic. Pneu. Tool.....	50¼
Int. Harv., com.....	88⅛	Cambria Steel....	42 - 44
Int. Pump, pref.....	5	Warwick	9½
Nat. En. & St., com.	9½- 9¾	Cruc. Steel, com..	12¼- 12⅞
		Cruc. Steel, pref.....	75
		La Belle Iron, com.....	27½

Large Output by Monessen Furnace

Remarkable production records were made at the No. 1 blast furnace of the Pittsburgh Steel Company at Monessen, Pa., in December and throughout the year 1914. The December output was 20,746 gross tons of basic iron and the greatest production for one day was 781 tons on December 26. For the year 1914 the output was 217,010 tons, an average monthly production of 18,084 tons and an average per day of 594.5 tons. The production by months was as follows:

January	18,480	July	17,420
February	15,239	August	17,450
March	17,410	September	17,320
April	18,320	October	18,570
May	19,808	November	18,173
June	18,074	December	20,746

The world's record for pig-iron production has been long held by the Duquesne and Edgar Thomson furnaces of the Carnegie Steel Company. In the days of higher iron content of Lake Superior ores records were made on Bessemer pig iron which have not been closely approached in recent years. Furnace E of the Edgar Thomson group made 918 gross tons of Bessemer pig iron on March 30, 1905. Duquesne Furnace No. 1 produced 832 tons of Bessemer iron on March 30, 1906. In recent years the best daily production reported for the Duquesne furnaces was 712 tons, this standing for a record for 1911, 1912 and 1913. The best monthly production reported for Duquesne on basic iron in recent years was 18,741 tons and the largest yearly output for one furnace was 198,575 tons.

German Pig Iron and Steel for October

According to the statistics of the Association of German Iron and Steel Makers, the pig-iron production for October was 729,841 metric tons, against 580,087 tons in September and 585,661 tons in August. The steel production for October is given as 900,201 tons compared with 663,223 tons in September and 566,822 tons in August.

By washing coal for a Kansas power plant 22.7 per cent. less ashes were handled than with unwashed coal, according to Prof. A. A. Potter, Kansas State Agricultural College. Equivalent evaporation was increased 23.6 per cent. About 17 per cent. of the coal was eliminated in washing, but the residue could be used in a gas producer.

The Government Ship Owning Bill

WASHINGTON, D. C., January 5, 1915.—The Senate is about to take up for consideration a measure of the highest importance to the American shipbuilding industry, to importers and exporters and to all persons directly or indirectly interested in our foreign trade. This measure is the so-called Alexander-Stone bill, authorizing the United States, acting through a shipping board, to organize a corporation to purchase, construct and operate merchant vessels in the foreign trade. The bill as presented in the Senate differs in important respects from the House measure, but the modifications have all been approved by the President and Secretary Redfield and the entire influence of the Administration is being exerted to bring about its passage. It represents, however, such a radical departure from the traditional policy of the Government that it has aroused strenuous opposition in both houses, and while Administration leaders of the Senate claim that it will pass that body by a comfortable majority, the contingent of Democratic members of the House who have declared their opposition to it is so strong as to make its fate in that body decidedly problematical.

The interests which the friends of the measure assert will be benefited by the bill are divided upon the question of its desirability. The shipbuilding industry as a whole is skeptical as to whether the measure will in any way stimulate either the building of more ships or their operation by private individuals in competition with the proposed Government-controlled corporation. Importers and exporters, whose chief interest is in securing ample shipping facilities for our foreign trade, are far from a unit on the bill, for while many of them believe that a material increase in the American merchant marine will result, others fear that the embarkation of the Government on such an enterprise will put an end to the efforts of private parties to increase our foreign shipping.

The Senate bill provides for the organization of a corporation, of which the United States will own 51 per cent. The initial capital stock is fixed at $10,000,000, but the shipping board, with the approval of the President, is authorized to increase it. The funds for the Government's share are to be derived from the sale of Panama Canal bonds to a total amount not to exceed $30,000,000, while the private capital is to be obtained by public subscription at par. The vessels thus purchased or constructed are to be used in the foreign trade only, except that they may engage in trade with the Philippine and Hawaiian Islands and the islands of Guam and Tutuila. The vessels are required to be of a type suitable for use as naval auxiliaries.

The bill contains no provision concerning the rates to be charged by the vessels operated, but the accompanying report places emphasis on the proposition that the corporation will provide shipping facilities at a fraction of the rates now charged. It is also suggested in the report, although the bill makes no provision to that effect, that after the American merchant marine has been sufficiently augmented, through the activities of the proposed corporation, the Government may sell its interest to private parties and withdraw from the shipping business. Shipbuilders are told that the bill "will create work for all shipyards not only in the construction of ships but in the matter of repairs." The fact that the bill leaves it entirely optional with the proposed corporation to purchase foreign vessels, instead of building them here, taken in connection with the necessity for promptly securing additional tonnage for the foreign trade, is likely to receive serious consideration by American shipbuilders who are called upon to favor or oppose this measure.

W. L. C.

Locomotive exports from England are reported as follows in Engineering of London: The locomotives shipped from the United Kingdom in November were valued at $1,735,000, as compared with $1,300,000 in November, 1913, and $1,120,000 in November, 1912.

VARYING SILICON AND CARBON*

The Effect on the Properties of Malleable Iron Castings

BY A. L. POLLARD

It has been the custom, since first malleable iron mixtures were made up by analysis, to consider silicon as the element of prime importance. It is only recently that the effect of carbon has been studied carefully. Professor Touceda has done a very great service to the industry by investigating this subject during the past year.

The writer's attention was first called to this subject by the accident of a very low carbon heat. The test wedges from this proved to have such excellent qualities that it seemed to offer a most interesting field for investigation. A record was therefore kept of the analysis and physical properties of every heat for a period of eight months and the data then correlated to show the effect of varying carbon and silicon.

The physical test used was that devised by Mr. Walker and standardized by Professor Touceda. Wedges 6 in. long and 1 in. wide by ½ in. at the base were cast, and annealed with the regular castings. The annealing was normal and was the same in all cases, the ovens being brought up to 1650 deg. F. in 18 hr., held at 1650 deg. F. for 72 hr., and cooled for about 60 hr. The wedges were then placed upon the anvil of a small drop hammer and were given a sufficient number of 70 foot-pound blows to fracture them.

The hard iron analyzed in every test about 0.175 per cent. phosphorus, 0.04 to 0.07 sulphur and 0.20 to 0.25 manganese. These elements therefore do not enter into this discussion. Only the carbon and silicon content were considered in gathering the tests into representative groups. There were of course variations due to improper annealing, shrinks, etc., but these were eliminated, provided the fracture showed the effect conclusively.

The condensed results are as follows: (Analyses given are for the hard iron).

First Series:
Carbon 2.30 to 2.40 per cent.
Silicon 0.90 to 1.00 per cent.—18 blows
Silicon 0.80 to 0.90 per cent.—24 blows
Silicon 0.70 to 0.80 per cent.—30 blows (1 test only).

Second Series:
Silicon 0.90 to 1.00 per cent.
Carbon 2.30 to 2.40 per cent.—18 blows
Carbon 2.40 to 2.50 per cent.—14 blows
Carbon 2.50 to 2.60 per cent.— 9 blows
Carbon 2.60 to 2.70 per cent.— 5 blows (1 test only).

Third Series:
Silicon 0.70 to 0.80 per cent.
Carbon 2.64 per cent.—15 blows (3 tests).

There was very little variation in the appearance of the above fractures. Most of them were dark gray with a lighter rim about 1/16 in. wide. The high silicon and high carbon fractures showed numerous crystals reflecting points of light. All samples were well annealed.

The physical properties as exhibited by the above tables, show uniformly high ductility on low carbon mixtures, and where both carbon and silicon are low the properties are unusually good. The actual number of blows which the low carbon series stood was not affected seriously by wide variations in the silicon content. The higher silicon irons seemed somewhat stiffer.

The series of varying carbon show, at the higher carbons, a great reduction of ductility. The results in this connection were most uniform and seem to give the carbon content an importance which has not been generally recognized.

*From a paper presented at the Chicago meeting of the American Foundrymen's Association in September.

In recording the above data along with the foundry records showing broken and hard castings, an interesting and unexpected result was observed. The broken work on a line of thin and difficult castings had been running 2.25 per cent., and the lost work around 12 per cent., when making an iron corresponding to the third series given above. As soon as a higher silicon and low carbon mixture was made, both the broken and bad percentages were considerably reduced, the broken averaging 1.50 per cent. and the bad 8 per cent. The writer cannot explain why this change should render the castings less liable to breakage, but believes that the higher fluidity was responsible for the reduction in the percentage of lost castings.

Aside from the technical aspects of this question there is an important economic aspect. With pig iron fairly high in silicon, a larger percentage of scrap can be used on high silicon low carbon mixtures. In a charge initially low in carbon, the silicon seems to have a lesser tendency to burn out. Especially is this fact of value in enabling the use of large quantities of malleable scrap. A further economic consideration is that the higher fluidity of the high silicon low carbon heats means less loss in melting and shorter heats. This greater fluidity is very pronounced.

In general, we conclude that where extreme ductility is desired the low silicon low carbon mixture is best, but for the average line of work a high silicon low carbon mixture will fulfill every requirement. It seems to reduce scrap and add greatly to the economy and ease of operation of the furnace.

German Iron and Metal Trade

War conditions in German industries are given as follows in data contained in the European papers recently reaching this side:

It is estimated that the large plants in Westphalia are operating now to the extent of 60 per cent. of capacity. An upward trend in prices of manufacture has not appeared, leaving little profit because of the dearness of raw materials.

In steel bars there is no uniformity in prices. Purchases are being made by jobbers and consumers, stocks in hand being low. In some cases basic steel bars are quoted at $25.06, net cash, at Oberhausen or Westphalian works. Small quantities are held at $27.98 for prompt delivery. Export business, though small, is going at domestic prices.

The wire rod situation is confusing. The dissolution of the Rod Syndicate has caused prices to give way, so that basic rods are now about $25.55 at works. Drawn wire is $27.98, and wire nails $29.20 to $29.32.

The Westphalian Hoop Iron Association has increased its prices $1.22 per ton for the first quarter due to increased cost of production. A previous advance was $3.65 at the end of August, which, with the present one, makes the quotation $32.85 on the freight basis of Oberhausen.

Recent negotiations in Berlin are said to have resulted in an agreement to make certain alterations in the constitution of the Spelter Syndicate. The syndicate has raised the price of spelter by $4.26 per ton for December-January delivery.

The Copper Sheet Syndicate, on December 10, advanced the price of copper sheets by $2.92 per 100 kg. to $488.43 per metric ton.

The Cleveland Foundry Company, Cleveland, Ohio, has received an order through its English agency for 10,000 oil heaters. It is understood that these will be used at the army camps in England.

The National Scrap Iron & Steel Association will hold its first annual banquet at the Hotel LaSalle, Chicago, on the evening of January 19.

OBITUARY

Thomas Lynch

The iron and steel world heard with great regret of the death of Thomas Lynch, president of the H. C. Frick Coke Company, at his home in Greensburg, Pa., on Tuesday, December 29, 1914. He had undergone an operation for peritonitis on December 16 and never rallied from its effects.

Thomas Lynch was born in Uniontown, Pa., on August 13, 1854, and was therefore in his sixty-first year. He was the son of Patrick and Nancy (Daniel) Lynch, both natives of Waterford county in Munster, Ireland, who came to this country several years before his birth. He attended the public schools of Uniontown until he was about 17 years of age, and that was the extent of his school privileges. He first clerked in a country store and later was employed for a year and a half in a wholesale grocery store in Pittsburgh. In 1875-76 he worked in company stores at the mines in the Connellsville district, including the Broadford (Pa.) store of H. C. Frick & Co. In 1877 Mr. Lynch was made superintendent of the Frick mine and coke plant at Dunbar, Pa., when the company had but a few hundred coke ovens. H. C. Frick was quick to appreciate his ability and his wonderful mastery of the details of the coke business and in 1882 he was appointed general superintendent of the H. C. Frick Coke Company. He was promoted to the position of general manager in 1890 and became president in 1897. He had been president of the company continuously since that time.

THOMAS LYNCH

Much of the great development and success of the Frick Coke Company was due to Mr. Lynch. Probably no other man had a wider knowledge of coke manufacture and of the commercial side of the business in all its phases. No small part of his success was due to the cordial relations he always maintained with the employees of the company. In an unusual degree he had the confidence of those who co-operated with him, and his attitude toward the men in the ranks gave him their respect and admiration. The thousands of workmen of the H. C. Frick Coke Company regarded him as their friend, one who was willing to go out of his way to help any employee if his case was just. As he visited the offices of the company at various places in the coke region he knew hundreds of employees whom he called by their given names, and in many homes of the workers he was known as "Mr. Tom." This relation was the basis on which so excellent a work has been built up by the welfare department of the Frick company. He insisted that living conditions should be as near ideal as possible and he gave much of his time and no small amount from his private fortunte to help his employees.

Mr. Lynch was president of a number of subsidiary companies of the H. C. Frick Coke Company, among these being the United States Coal & Coke Company of West Virginia, the Sharon Coal & Limestone Company of Sharon, Pa.; the Republic Coke Company and Hostetter-Connellsville Coke Company of Uniontown, the National Mining Company of West Virginia and the Bunsen Coal Company of Illinois. He was a director of the Mellon National Bank, the Union Trust Company, and the Union Savings Bank of Pittsburgh, and also a member of the Duquesne Club. He was married in 1879, and leaves his widow, one daughter and four sons. The funeral services were held from his home in Greensburg, Pa., on Friday, January 1, and were attended by a large number of officers of the United States Steel Corporation, the Carnegie Steel Company, H. C. Frick Coke Company and allied interests.

James A. Farrell, president of the United States Steel Corporation, has paid this tribute to Mr. Lynch: "Thomas Lynch was one of the most capable men associated with the United States Steel Corporation. His judgment was keen and well balanced, and he was a deep student of conditions and a patient master of the intricate problems of the mining industry. Those of us who worked side by side with this strong man remember him as one without fear and without reproach. It is a rare tribute to the self-effacing modesty of this notable figure in the world's work that those who survive him will remember that his genial face and kindly disposition softened many of the asperities which belong to the ever-changing details in the conduct of a business. From his official associates down to the workmen in the mine, there remains respect and a positive affection for the master mind who so suddenly was called away. When a strong man drops out of the ranks in his prime, the ranks move on, as they must, but Mr. Lynch's associates will always miss the inspiration and spirit that was loyal through the whole length of his career."

EDWIN NORTON, the first president of the American Can Company, died December 31 at his home in New York City of heart disease, aged 69 years. He was born in Rockton, Winnebago County, Ill., was educated in the public schools, saw military service in the Civil War, and then turned his attention to the manufacture of articles from tin plate. Being of a remarkably inventive turn, he perceived opportunities for greatly expediting the manufacture of tin cans and founded an establishment at Maywood, a suburb of Chicago, which was devoted to that specialty. Interested with him in this ambitious enterprise was a younger brother, and the firm was known as Norton Brothers. The machinery invented and from time to time improved by Mr. Norton was not only ingenious but most comprehensive, as it covered the entire and continuous operation of manufacturing tin cans, from forming the cut sheets into bodies and tops, mechanically soldering the different portions, testing the cans for their air-tight qualities and conveying them either to a warehouse or to cars for shipment. The business grew to such proportions that the firm embarked in the manufacture of tin plate shortly after the McKinley tariff was enacted, and Mr. Norton's inventive genius displayed itself in this branch of industry in his invention of various machines to do away with hand labor. Being a large consumer of solder, which it was desirable to have in sheets, he invented a machine for rolling the molten solder directly into sheets. He also turned his attention to the manufacture of steel sheets for tin plate and spent much time and money on a process for rolling sheets directly from the molten steel, but while this was not a failure it was not commercially successful. Mr. Norton was a most prolific inventor. It is said that he had been awarded more than 5000 patents. The can-making business, with others in the same trade, was absorbed in the American Can Company. He leaves his widow, two sons and three daughters.

H. E. McWANE, president Lynchburg Foundry Company, Lynchburg, Va., committed suicide December 31, aged 54 years. For several years he had been a sufferer from physical and mental troubles. He was born at Wytheville, Va., and had been a resident of Lynchburg for the past 29 years. He was brought up in the foundry business, in which his father had been prominent. He leaves his widow, four sons and six daughters. His son Lawrence is general manager of the company.

FREDERICK K. FITLER, treasurer of the Somers, Fitler & Todd Company, Pittsburgh, dealer in machinery and mill supplies, died in Atlantic City, N. J., December 31, after a long illness. He was born in Pittsburgh and educated in the public school and Newell Institute. He assisted in forming the company of which he was treasurer, but he has not been active in business for several years. He leaves his widow and a son.

JAMES C. CLOW, secretary and vice-president of James B. Clow & Sons, Chicago, and a son of the founder of the company, died December 25 at his home at Lake Forest, Ill., following an illness of several months, which had forced his retirement from active business. He was 40 years old and had been secretary and vice-president of the company since 1910.

Witherbee, Sherman & Co. Improvements

At the iron mines and iron ore concentrating mills of Witherbee, Sherman & Co., at Mineville, N. Y., the most important surface improvement in 1914 was the building of mill No. 5 to take the place of mills Nos. 1 and 2 destroyed by fire June 17, 1914. Mill No. 5 is located on the site of the old No. 1 mill and is of fireproof construction throughout. Concrete blocks are used for exterior and reinforced concrete beams and floors in the interior. The conveyor frames and decking will be of iron, as well as the frames for the magnetic separators, so that very little wood will be used. The building is now inclosed and will be completed for running about April 1, 1915. The capacity of the mill will be about 120 tons per hour, which will take care of the output of Old Bed ore from Joker and Bonanza shafts.

The most extensive development work for the year has been done underground. About $300,000 has been spent in extending new slopes to develop ore bodies ahead of the working faces, and this work has been kept going although the production has been curtailed. Electric hoists have been installed underground on these slopes which discharge ore either directly into pockets at the foot of the vertical shaft or otherwise deliver to electric tram levels which in turn deliver to the pockets of the vertical shaft.

Remarkable Steam Response from Banked Fire

In a test made recently at the Scott street station of the Toronto Electric Light Company, Ltd., Toronto, Canada, a 554-hp. Babcock & Wilcox boiler equipped with a Riley stoker was brought up to 354 per cent. of rating in 7 min. This remarkable performance was made possible by the moving grates of this type of underfeed stoker. Before starting this test the boiler was on a live bank, that is, the boiler pressure was just below the normal 150 lb. and sufficient coal was being fed to maintain this furnace condition. A man in front of the boiler gave the signal to start the stoker fan when the steam pressure had dropped 5 lb. below normal and this was taken as the time of starting the test. This plant is used as a reliability reserve or "standby" for the hydroelectric power generated at Niagara Falls. It is maintained at all times with a live banked fire in a boiler furnace and is in readiness to pick up the load in case of interruption to the hydroelectric power supply. This steam station contains four 554-hp. Babcock & Wilcox boilers, each equipped with a six-retort Riley self-dumping underfeed stoker. Forced draft for the four stokers is supplied by a Sturtevant double-width No. 10 Multivane blower, driven direct connected by 125-hp. direct-current motor.

PERSONAL

The steam boiler code committee of the American Society of Mechanical Engineers has been enlarged by the appointment of an advisory committee. Included in this additional committee are Prof. D. S. Jacobus, advisory engineer, Babcock & Wilcox Company; F. W. Dean, consulting engineer, Boston; Thomas E. Durban, general manager, Erie City Iron Works, Erie, Pa., and Sherwood F. Jeter, Hartford Steam Boiler Inspection & Insurance Company.

Charles T. Henderson, Cutler-Hammer Mfg. Company, Milwaukee, is to address a meeting of the Association of Iron and Steel Electrical Engineers, at the Seventh Avenue Hotel, Pittsburgh, Saturday evening, January 9, on the standardization of magnetic switch-type controller requirements.

Louis Willputte, vice-president and general manager Otto Coking Company, 6 Church street, New York, recently returned from a business trip to England.

A. E. Borie recently tendered his resignation as chairman of the board of directors of the Taylor-Wharton Iron & Steel Company, taking effect January 1, in order to devote his time to the American Road Machinery Company and the Good Roads Machinery Company, of both of which he is chairman of the board of directors, and to other interests. He remains a director of the Taylor-Wharton Iron & Steel Company.

William Lewis, formerly assistant superintendent of the plant of the Youngstown Iron & Steel Company, Youngstown, Ohio, has resigned to become general superintendent of the new sheet mill plant of the Western Reserve Steel Company, Warren, Ohio, which is expected to be put in operation this month.

Samuel A. Benner, who some months ago went to England for the Pittsburgh Coal Company to investigate foreign sales of coal, has returned to Pittsburgh.

E. L. Hill, formerly superintendent of the insulated wire and power cable plant at Worcester, Mass., of the American Steel & Wire Company, is now consulting engineer of the Hazard Mfg. Company, Wilkes-Barre, Pa.

Rufus R. Shafter has been appointed New York manager of the Chester Steel Castings Company, with headquarters at 81 Fulton street.

Frank F. Amsden has been engaged as furnace manager by Joseph E. Thropp, Everett, Pa.

L. M. Bowers has resigned as chairman of the board and treasurer of the Colorado Fuel & Iron Company. He expects to take up his residence at Binghamton, N. Y., which had been his home previous to his connection with the Colorado company.

John Sherwin was elected president of the Bishop-Babcock-Becker Company, Cleveland, Ohio, at the recent annual meeiing, succeeding J. H. Champ, who was elected chairman of the board of directors. G. E. Collings, who succeeds Mr. Sherwin as treasurer, is a Cleveland banker and will not engage actively in the management of the company's affairs. E. T. Sargent was elected secretary and assistant treasurer and L. A. Becker was appointed general sales manager.

James Fox, superintendent of the foundry of the Best Mfg. Company at Oakmont, Pa., has resigned and is now connected with the foundry department of the Union Switch & Signal Company, Swissvale, Pittsburgh.

N. C. Woodin, formerly designer and engineer for the International Hoist Company, Antigo, Wis., is in charge of operations of the recently incorporated Utility Steel Tractor Company at the same place.

The No. 2 Ashland furnace at Ashland, Ky., was blown out December 29, on account of unsatisfactory conditions in the pig-iron market. This period of inactivity will be utilized for making repairs and installing a pig casting machine.

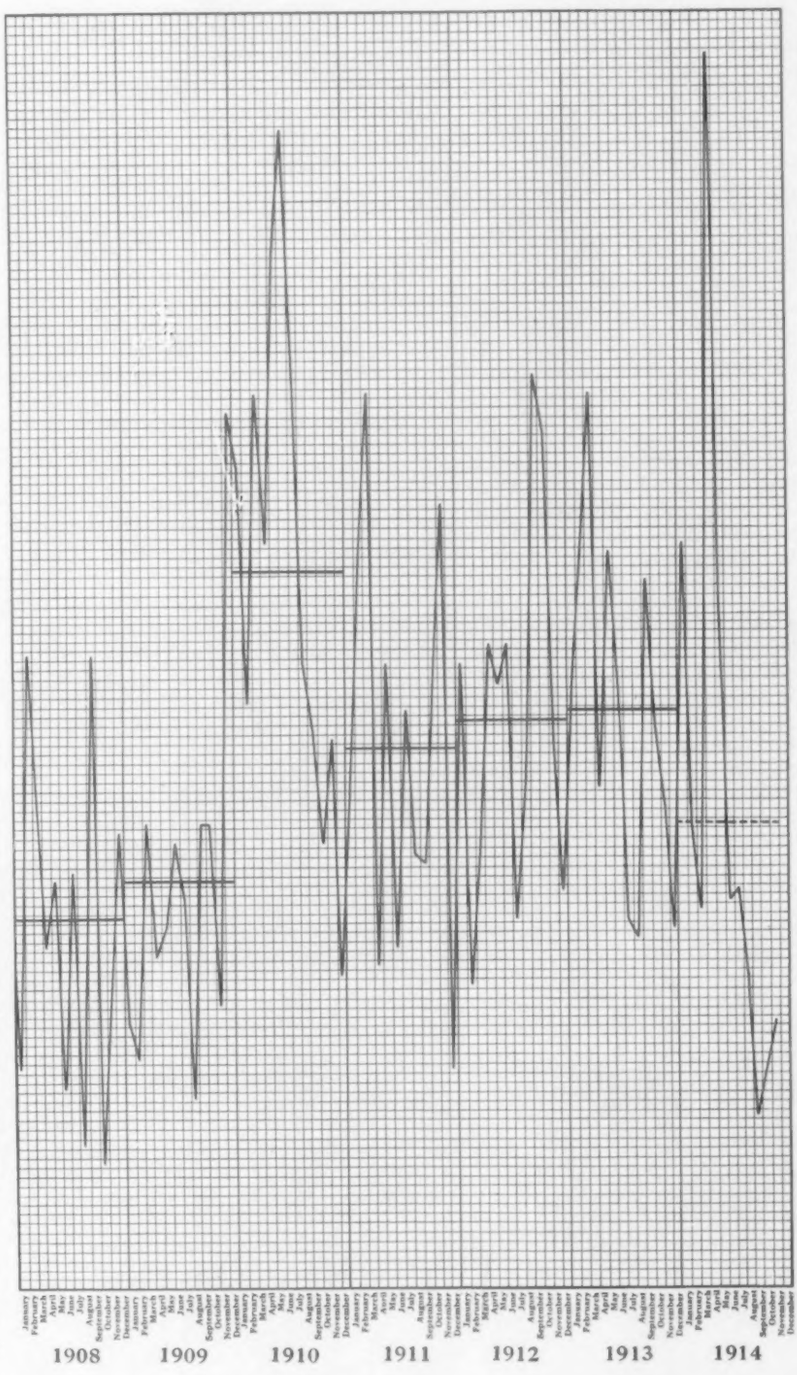
The Machinery Markets

General Review of 1914

The dominant feature of the year just closed was the placing of export orders for machine tools to supply the demands of war. The aggregate value of these orders approximates $10,000,000, according to some estimates and these figures are probably correct if they are intended to include domestic orders for tools to make war material as well as arms-making equipment ordered by foreign countries. How much has been spent for arms, ammunition, shrapnel and like requirements, all of which will be made here with American machines, is a matter of conjecture, but the sum is large and has dictated the buying of many thousands of dollars' worth of machine tools. At least 2500 engine lathes have been purchased for export, while the number of automatic screw machines and turret lathes bought has run into the hundreds. All of the allied governments have been purchasers. Grinding and milling machines have also sold well, with a sprinkling of other types of machines.

The prospect of making shrapnel for the foreign powers has engrossed the attention of many firms in this country, the demand for whose regular product was below normal. Most of these firms made tentative inquiry for the machinery they would need if they received contracts. The placing of the orders has moved with disappointing slowness, however, and only a few concerns are actually engaged in making shrapnel.

Unfortunately, the foreign business resultant from the war has not spread equally over all lines of metal-working machinery.



Fluctuations, by Months, from January, 1908, to December, 1914, in the Sales of a New York Seller of Machine Tools Doing a Domestic Business Only. Horizontal Lines Indicate Averages

THE TREND OF THE YEAR

Entered hopefully, as new years usually are, January and early February showed some improvement over the quiet end of 1913, but the betterment came slowly, merged into irregularity and March was a disappointment. April brought more activity, but soon was followed by quiet and then dullness. In June business again was better, but it was only a spurt of buying and the market was dull and uncertain until September, when a slow though steady upbuilding of domestic demand set in, which was overshadowed by the great war orders. The betterment lasted into the holidays.

Throughout the year the trade suffered most severely from the lack of railroad buying, but events of late December promise to alleviate this condition to some extent.

In accordance with its yearly custom, *The Iron Age* sent letters to a number of railroad executives asking them to indicate, as far as they could, what the machinery trade might expect from the railroads, especially in view of the prospects of a favorable freight decision in the case of the application of the Eastern lines to the Interstate Commerce Commission. The letter reached most railroad officers before the decision, but many gave interesting replies. Following are some representative extracts:

OPINIONS FROM RAILROAD EXECUTIVE OFFICERS

J. A. McCrea, general manager Long Island Railroad:—The Long Island Railroad will only purchase shop tools along the lines of a normal replacement during 1915.

Edward B. Pryor, receiver Wabash Railroad:—It is my opinion that if the railroads are granted the in-

crease in freight rates there is no question that there will be an immediate revival of purchasing railroad supplies of every nature, not only machine tools and general shop equipment, but everything that the railroads so badly need for the repairs which have been delayed for a long time.

W. J. Press, M. E. Transcontinental Railway, (Canada):—During the year 1915 we shall spend probably $550,000 on machinery and machine tools for our Quebec shops. Of this, our power house equipment, including engines, generators, boilers, etc., will run to about $150,000, while the cranes, machine tools, and miscellaneous equipment in the shops will probably cost $400,000.

W. G. Besler, president Central Railroad Company of New Jersey:—This company has not changed its policy in any manner in the matter of keeping up with necessary bad order repairs, etc. We have taken the opportunity to overhaul and place new bottoms in 1000 steel coal cars which are approximately 13 years old, and which were the first received by this company. We do not expect to purchase any considerable quantity of new machinery, as we have purchased from time to time, as our necessities required, any tools and appliances that were essential to keep fully abreast of our requirements.

W. J. Harahan, president Seaboard Air Line:—We need a great deal of shop equipment but are prevented from doing anything by reason of the financial conditions brought about by the war and other influences.

L. F. Loree, president Delaware & Hudson:—My feeling is that the advance in freight rates recently granted by the Interstate Commerce Commission will relieve to some extent the distress of the railroads so far as their earnings are concerned, and enable them to sustain their credit on a sound basis; but I do not believe that it will give them any additional purchasing power at the present time. I think the psychological period was passed last fall to effect a forward movement in production.

H. R. Kurrie, president Chicago, Indianapolis & Louisville:—What this particular company most needs is business. An increase in rates is very desirable and it must come if we have permanent prosperity, but an increase in rates without an increase in business is not going to help.

W. G. Bierd, president Chicago & Alton:—It is my belief that the outlook for 1915, for all forms of business, including railroad supplies, is very much brighter. There is no question that the increase in freight rates just granted will be of great benefit, not only to the railroads, but to the whole country.

Frank Sullivan Smith, receiver Pittsburgh, Shawmut & Northern:—While thus far in the fiscal year we have been compelled to defer practically all purchases of machinery, tools and other shop equipment and have practically suspended all heavy repairs to equipment, including work which we had begun in installing steel underframes on 2000 wooden cars, I shall hope to renew normal operation in our divisional shops both in New York State and Pennsylvania, in case relief is given by the Interstate Commerce Commission in granting the increase in freight rates asked for by the Eastern roads, or as soon as business shall have increased sufficiently to give earnings to justify such operation.

E. P. Ripley, president Atchison, Topeka & Santa Fé:—The buying of machine tools and general shop equipment, should gross earnings hold up satisfactorily, will be probably somewhat larger in volume in 1915 than it was this year. Our miscellaneous purchases in general will, in fact, be probably of a volume somewhat greater next year than for the past two or three years, for the reason that our stocks are fairly low and will require some replenishment. Our budget for next year has not yet been passed and I am unable to give you specific data on what our purchases are likely to be. Should the action of the commission in the Eastern rate case be followed by favorable action on applications for increases by the Western lines, the entire country ought to be greatly benefited and general buying by railroads as a whole stimulated when sufficient time has passed for their treasuries to feel the effects.

H. L. Ingersoll, assistant to President A. H. Smith, New York Central Lines:—An improvement in general business conditions, or a rate increase, should help the income of the railroads. More traffic will require more transportation service, which in turn requires more use of facilities for the upkeep and more supplies.

S. M. Felton, president Chicago Great Western:—We will not do much in the way of purchases of machinery and tools and shop equipment the coming year for the simple reason that we have just gotten through remodeling our shops and purchasing modern tools and machinery. If we were in need of anything of the kind I would be disposed to go ahead as soon as we get some definite indication of the attitude of the commission toward the Western rate increases, but, fortunately, we are not obliged to do anything.

H. B. Chamberlain, receiver Tennessee Central:—We are of the belief that it will be some time before railroad buying will become more nearly normal. The increase in freight rates authorized by the Interstate Commerce Commission will only be operative in the Official Classification territory, and it will be some time before the roads in that territory will feel the benefit of the increased rates based on the present condition of business. Speaking from the standpoint of railroads in the South, which are not affected by this recent increase in rates, and the present business condition being far below normal, it will be some time before the railroads in this section of the country will be in the market buying on what you term a more nearly normal basis. The decreases shown by roads in the South speak for themselves, and it is safe to predict that there will be no marked purchases by such roads in the immediate future, as they are hardly able now to purchase actual necessities.

The president of an Eastern railroad points out that the Interstate Commerce Commission granted a 5 per cent. increase on but approximately half of the tonnage carried by some lines, inasmuch as these roads carry a great deal of coal, coke and iron ore which are excepted from the increase. Many other officers write that in their opinion the recently granted permission to advance rates will certainly increase buying, though several emphasize the point that an increase in freight traffic is an essential. Some of the Western companies, and others in the South that do not benefit from the decision, can see no prospective betterment with their companies. Several others say they have kept their lines up to par, so far as essential improvements are concerned and see no necessity for buying except to make occasional replacements.

The Year in New York City

In general, the trend of the New York market was similar to that of the country. Large lists of machine-tool requirements were few, indeed, and some of the few were never closed. The Seaboard Air Line, for instance, issued a list early in the year, then revised it, but did not place the business. The Union Pacific was a purchaser in February. The Chesapeake & Ohio asked for estimates on an attractive list in the spring, but the orders are still unplaced. Aside from the war business, in the last half of the year, probably the best buying was on the part of automobile parts manufacturers, one of whom gave an order for over 50 automatic screw machines in March. Ball and roller bearing makers were also generous purchasers.

After the European war became strenuous, large

orders for machine tools were placed by the Bethlehem Steel Company, the E. W. Bliss Company and the Baldwin Locomotive Works, the last-named company acting for Russia. The demand on the Niles-Bement-Pond Company was so great at one time that the company bought machines from other manufacturers. Large orders were placed also through the Allied Machinery Company of America, while others, large and small, were placed by exporters, foreign representatives and through companies having foreign connections. Some tool builders start this year with their plants filled with work.

The chart given on page 124 shows the fluctuations from 1908 to December, 1914, by months, in the business of a local machine-tool seller doing a domestic business only. The black horizontal lines indicate the yearly averages and the dotted line the average for 11 months of 1914.

The Week

That the year opens with business more active is the opinion of dealers in machine tools and local branch managers representing manufacturers. Without exception they say the outlook is brighter, the view being based on the fact that business was greatly improved in the last week of December, while some good orders came along in the first business days of 1915. Purchasing in the last week of December was sufficient to make the average for the month at least fair with some sellers. The demand called for a varied assortment of tools and came from miscellaneous sources and there is an inquiry out which would seem to indicate a continuance of the business. The Pennsylvania Railroad is inquiring for a 6¼-in. turret lathe for bar and chucking work. A company building locomotives is inquiring as to whether certain machines can be promptly supplied in case it is determined to buy them. A New York company which makes meters has purchased a small list of machines. A dealer booked a good order for export in the week and quotations have been submitted on a large quantity of similar business. One manufacturer has quoted on 230 machines for export but instructions to place orders are coming slowly from abroad.

A news dispatch from Pittsburgh quotes E. M. Herr, president Westinghouse Electric & Mfg. Company, as confirming a report that his company has received an order amounting to about $750,000 from the Washington Steel & Ordnance Company. He said the order is to be filled as quickly as possible and that it involves material for ordnance use and that his company is not concerned with the ultimate destination of the product. The report states that the order calls for about 152,000 shrapnel shells, of which 100,000 are to be of a small size and 52,000 of a larger size. The Washington Steel & Ordnance Company, Washington, is known to have received a foreign order for shrapnel and has bought machine tools for their manufacture.

The Samuel L. Moore & Sons Corporation, Elizabeth, N. J., which has been making various improvements to its plant, is in the market for a number of machine tools, including a 12-ft. boring mill.

The Eastern Grain, Mill & Elevator Corporation, Buffalo, recently incorporated with a capital stock of $1,000,000, will erect on the Buffalo River a reinforced concrete elevator with a capacity of 1,000,000 bu. The new corporation is a consolidation of the Eastern Grain Company, the Iron Elevator & Transfer Company and the Eastern Milling Corporation. Offices are to be maintained in the Marine National Bank Building. Nisbett Grammar is president.

The Commercial Research Company, Tuckahoe, N. Y., will erect a two-story plant on Midland avenue from plans prepared by Samuel M. Greene & Co., Port Chester, N. Y. The plant will be equipped for the manufacture of platinum filaments for tungsten lamps, etc., at a total estimated cost of $25,000.

W. B. Osborne, president of the New York State Training School for Boys, 2 West Forty-fifth street, New York City, is receiving sealed proposals until January 12 for a water supply system, construction work of a power house, etc.

The Farmersville Mfg. Company, Farmersville, N. Y., plans to rebuild its factory recently destroyed by fire.

Smith Brothers, Poughkeepsie, N. Y., have plans in preparation for a factory for the manufacture of cough drops and chewing gum, 140 x 191 ft., two stories and basement, of brick and steel construction, to cost approximately $100,000. They will also build a candy factory and bakery, 45 x 80 ft., two stories and basement, of brick and steel, to cost about, $40,000.

The Eisler Mfg. Company, 109 Hauge street, Rochester, N. Y., has let the contract for a machine shop, 48 x 110 ft.

Bids will be received until January 21 for a boiler and stack for the Binghamton State Hospital, Binghamton, N. Y., by Lewis M. Farrington, Albany, N. Y.

The Philadelphia & Reading Railway, Philadelphia, Pa., has awarded the contract to H. E. Baton, Tenth and Sansom streets, Philadelphia, for the construction of a one-story brick boiler house for Port Reading, N. J. William Hunter is the chief engineer.

The Philadelphia Quartz Company, 121 South Third street, Philadelphia, will erect a factory in West Armourdale, a Kansas City, Mo., suburb, at an estimated cost of $100,000. Construction work will start shortly after January 1. W. H. Stanton, Philadelphia, will be factory manager.

The York Corrugating Company, 13 South George street, York, Pa., manufacturer of pipe, cornice work, etc., has been awarded the contract for the construction of a one-story brick and steel factory, 176 ft., square, to be used for the manufacture of corrugating roofing and sheet metal specialties, etc. The present factory will be used exclusively for the manufacture of conductor pipe and eaves trough. The total estimated cost is $22,000.

New England

A Review of 1914

BOSTON, MASS, January 5, 1915.

Manufacturers do not look back over 1914 with any great degree of pleasure. Generally speaking, it has not been a twelve months of prosperity. Grouping together the machine-tool and supply trade, there were bright spots here and there in the first half of the year, and then, in the midst of the summer dullness, the great war had its totally unexpected beginning. Industry was paralyzed for the time being, for no one knew what to expect and a period of readjustment was inevitable. Millions of dollars' worth of orders for shipment abroad were either canceled or held up, and it looked as if the machine-tool business had been hit a hard blow.

Then came the reaction. Orders for all sorts of munitions of war and supplies for army purposes began to pour in. A rapidly growing demand followed for machine tools of various descriptions—engine lathes, automatics, screw machines, cylindrical grinding machines, everything that could turn projectiles. In addition came orders for machinery to equip arms factories and the special machinery used directly in the manufacture of rifles. Planers, shapers, the larger drilling machines and certain other types have been in less demand, but probably this division of the business has improved to some extent. Machinery suitable for turning artillery projectiles has become almost scarce. In fact, 14, 16 and 18-in. engine lathes are nearly out of the market, and the makers are running their works full in order to replenish their stocks and take care of current orders, which have by no means ceased. On the whole, the machine-tool business has had one of the greatest revivals it has experienced in years. At the beginning of the Russian-Japanese war certain stocks were wiped out without much warning; but it was rather a transient business. That of today continues with a considerable degree of steadiness.

The electric equipment companies have had a year more or less similar to that of the machine-tool trade, though the revival has not been so acute. The paper machinery people have been prosperous ever since war conditions made it evident that the country's supply of paper must be increased. The textile machinery makers have had an uneven experience. A few lines have been quite active; others have been uniformly dull. On the whole, machine shops everywhere have not been prosperous.

The iron foundries are showing signs of reviving business after months of comparative stagnation. Makers of foundry supplies report increasing orders.

The year starts with a general expectation of improvement. It is believed that the worst is over and that the volume of business will increase from now on, gradually, perhaps, but surely.

The Week

The buying of machinery continues without abatement. Some inquiries mentioned last week have developed into orders. The new demand is more general than at any time in several months, and no longer is confined to requirements resulting from the demand for war materials.

One of the most important transactions in years in the machinery industry is the purchase by the Pratt & Whitney Company division of the Niles-Bement-Pond Company, Hartford, Conn., of the great neighboring plant of the Pope Mfg. Company, recently used for the manufacture of automobiles. The sale was ratified last week by the superior court of

Connecticut, which authorized the receiver of the Pope company to complete the transaction. The price is about $300,000 cash. The Pratt & Whitney Company stands in great need of additional manufacturing space. Its works, which are among the largest in the world for manufacturing machine tools, are simply overflowing with business. In fact, other shops have been called upon to furnish important parts of the Pratt & Whitney products, not only those of Hartford and vicinity, but of other New England cities. Its orders are in such great volume that business has been turned away. The Pope property is contiguous to that of the Pratt & Whitney Company, and has a frontage of 565 ft. on Capitol avenue and a depth of 450 ft. On it are 24 buildings, most of them modern and one of them completed only 15 months ago at a cost of $135,000. The Pratt & Whitney officials are reticent concerning their plans; but the understanding is that the new building will be occupied for manufacturing as soon as deeds are passed, in the beginning, for erecting purposes, and several hundreds of additional men will be put to work.

The changes which the Billings & Spencer Company, Hartford, Conn., will make immediately in the recently acquired plant of the Columbia Motor Vehicle Company will cost about $100,000. An important reason for the improvements is the necessity for relieving the forge and machine departments, which will be given prominence in the new works. The Billings & Spencer Company already has two large plants, one in Hartford, which may be called the parent factory, the other in Dividend, a suburban neighborhood. The growth of the business has been rapid. The demand for the products—drop forgings, mechanics' tools and forging machines—has increased rapidly. The opportunity to purchase the great Columbia factory was exceptionally fortunate. The former owners distributed its forging between two departments, and these will be consolidated, in a building which will be 80 by 350 ft., the present roofs to be replaced by one of steel. The machine department will be installed in the north wing, the interior of which will be reconstructed for the purpose, especially to give greater head room. Steel work will carry the weight of the upper floors. Several cranes will be installed, and other new equipment will be purchased, of which, the company states, no list has been prepared. A boiler house is also planned.

The Stack Heater Company, recently doing business in Boston as the Somerville Mfg. Company, manufacturer of gas water heaters, has taken a lease of part of the building at Harding and Cherry streets, Worcester, Mass. The business has been incorporated with E. S. Stack as president and Chetwood Smith, Worcester, as treasurer.

The Locomobile Company of America, Bridgeport, Conn., manufacturer of automobiles and motor trucks, has taken on new manufacturing space by leasing an additional floor of the Bridgeport Engineering Company's building, and will employ between 150 and 200 additional hands. It is buying new machinery, as was stated last week. Recently received orders for motor trucks are presumed to be responsible for this additional activity.

Announcement is made in New Haven that the Winchester Repeating Arms Company, New Haven, Conn., has acquired the works of the Imperial Sewing Machine Company on Canal street, and will immediately utilize it for manufacturing. It is making, or is about to make, large additions to its factories. Building permits have just been taken out for two factories respectively 41 x 106 ft. and 60 x 104 ft., three stories and basement, of reinforced concrete.

The Torrington Electric Light Company, Torrington, Conn., has awarded the contract for a power house, 16 x 42 ft., one story.

Indianapolis

INDIANAPOLIS, IND., January 4, 1915.

The Merchants Heat & Light Company, Indianapolis, has increased its capital stock from $1,500,000 to $2,000,000 to provide funds for filling its new lighting contract with the city. The company has part of the equipment from the Westinghouse Electric & Mfg. Company.

The Mutual Motors Company, Indianapolis, has been incorporated with $1,000,000 capital stock to manufacture automobiles, etc., by J. I. Handley, B. M. DeLamater, T. A. Campbell, W. R. Smith and T. E. Barkworth.

The United Novelty Company, Indianapolis, has been incorporated with $20,000 capital stock by A. B. Ayres, F. M. Milligan and S. Strong.

The Standard Plating & Brass Foundry Company, Anderson, Ind., has been incorporated with $5000 capital stock by M. A., A. O. and A. D. Farver.

Emil Stroh, Milford, Ind., has the franchise of the operation of an electric light plant, and will install necessary equipment.

The Middlebury Electric Company, Middlebury, Ind., has been incorporated with $10,000 capital stock to supply electricity. The directors are G. A. Robinson, O. H. Furr and A. H. Gillespie.

The United Public Service Company, Rochester, Ind., has been incorporated by J. E. and E. E. Beyer and C. A. Davis, with $250,000 capital stock.

The Akron Light, Heat & Power Company, Akron, Ind., has increased its capital stock from $5000 to $15,000.

At a receiver's sale of the Portland Foundry & Machine Company, Portland, Ind., the equipment was purchased by C. C. Cartwright, L. G. Holmes, J. A. Long and George H. Smith, stockholders, for $15,000. They will continue the plant in operation.

The Aluminum Holloware Company, Marion, Ind., has been incorporated with $10,000 capital stock to manufacture aluminum products. The directors are H. E. Newbrough, G. D. Soultz and G. F. Truman.

The Newton County Stone Company, Kentland, Ind., has increased its capital stock from $15,000 to $40,000.

The Anderson Folder Company, Anderson, Ind., manufacturer newspaper and magazine folders, contemplates enlarging its plant.

The Reesh & Carter Heating & Plumbing Company, Mishawaka, Ind., has been incorporated with $5000 stock to manufacture and deal in plumbing supplies. C. E. Reesh, M. Reesh and Wilford Carter are the incorporators.

Chicago

CHICAGO, ILL., January 4, 1915.

The past week brings to a close in the Chicago machinery market a year of disappointment. At no time has there been what might be termed good business. The comparatively brief periods during which larger sales gave rise to hopes of permanent improvement were usually brief indeed. Sales have been not only few but at low prices and of the kind costing most to effect. The railroads have scarcely put out a single list of importance, and two of the more important are still in suspense. The demand for tools occasioned by the equipping of foreign arsenals and field repair outfits brought some business to the west by reason of the great insistence upon immediate shipment. Western builders of turret lathes were especially fortunate. Local representatives of eastern tool builders were able also to move some of the stock they had on the floor in assisting those builders to fill orders taken. Considering the general business conditions the year witnessed a reasonable expansion of industrial operations, but a disposition to install second-hand tools was more pronounced. New equipment appears to have been purchased with few exceptions in small lots or a tool at a time.

The Northern Pacific Railway Company recently placed orders for a number of machine tools and railroad shop equipment which are to be installed in a new locomotive repair shop at St. Paul, Minn. The list included one 24-in. x 24-in. x 8-ft. planer, one 32-in. stroke draw-cut shaper, one 3-in. x 36-in. flat turret lathe, one 18-in. x 8-ft. engine lathe, one 5-ft. radial drill, one 36-in. upright drill, one 2-in. double head bolt cutter, one band saw, one superheater tube-welding machine, one 100-ton locomotive box and forcing press, one combination wet and dry grinder, one 1250-lb. steam hammer, one pipe-bending machine, one 16-in. by 6-ft. tool room lathe, one pipe cutting and threading machine, one horizontal cutter and keyseat drilling machine, one portable crank-pin turning machine, one surface grinder to grind 18-in. by 8-ft. and one 42-in. vertical turret lathe. All machines were arranged for electric drive.

The Perkins Skinner Valve Company, Chicago, has been incorporated with a capital stock of $20,000 by Richard A. Holland, 29 South LaSalle street, John A. Massen and M. H. Forner to manufacture valves and other devices.

L. G. Hallberg has prepared plans for the Stewart Warner Speedometer Company for a six-story factory, 77 x 125 ft., to be erected at Wolfram and Lincoln streets, at a cost of about $100,000.

The Irwin D. Groak Engineering Company, Chicago, has been incorporated with a capital stock of $50,000 by Charles S. Hancock, Joseph L. Wilson and Irwin Newmann, 53 West Jackson boulevard.

Williams, Shaffer & Haley have purchased the machinery and outfit of the Benton Machine Shop, Benton, Ill., where they have also purchased a large brick garage. Their shops in Eldorado will be removed to Benton and it is their intention to pay particular attention to mine and automobile work.

The Rock Island Plow Company, Rock Island, Ill., is having plans prepared by C. D. McLane, 301 Robinson Building, for an addition to its machine shop, one story, 50 x 90 ft.

The Elaborated Roofing Company, Chicago, has purchased a four-acre plot of ground at Berwyn, Ill., and will erect a brick building.

Arrangements are now being completed between the Platford Mfg. Company, Elgin, Ill., which was recently incorporated for $100,000, and W. V. Perry, for the establishment of a plant to manufacture a patented gas-steam radiator.

The U. S. Wheel & Tire Company has purchased a site for a factory building at Rockton, Ill. The company was recently organized under the laws of South Dakota and will manufacture automobile wheels.

The Peoria Tractor Company, Peoria, Ill., has been incorporated with a capital stock of $100,000 by George McFarland, G. G. Loomis and E. M. Smith and will manufacture tractor equipment.

Fire destroyed the machine shops of the Lake Erie & Western Railroad Company at Tipton, Ind., causing a loss estimated between $50,000 and $75,000.

The Wisconsin Specialties Company, Oshkosh, Wis., has been incorporated with a capital stock of $10,000 to do a general manufacturing business, with special reference to furniture and cabinet work and wicker novelties. The incorporators are Henry Kossell, Eugene Smith and George B. Caswell.

The roundhouse of the Duluth, Winnipeg & Pacific Railroad at Duluth, Minn., has been burned. The damage to the building is estimated at $50,000 and to locomotives $100,000.

The Hubbard Company, Cedar Rapids, Ia., has been reorganized and a large ice plant will be installed.

Milwaukee

MILWAUKEE, WIS., January 4, 1915.

An authentic review of conditions in the metal trades in the Milwaukee district for 1914 shows a falling off of approximately 26 per cent. in the production as compared with the previous year. Gen. Otto H. Falk, president Allis-Chalmers Mfg. Company, says the outlook for 1915 is not overencouraging, but with the prospect of an early return of the railroads to the market improvement is bound to result. New business during the month of December was the smallest of the year.

The Citizens' Association, Manitowoc, Wis., has broken ground for the foundations of the new machine shop to be provided for the Atlas Engineering Company, Milwaukee, Wis., manufacturer of concrete mixers.

The Honold Mfg. Company, Sheboygan, Wis., has been incorporated with $50,000 capital stock to manufacture iron beds, metal ladders, undertakers' appliances and similar devices.

The Utility Steel Tractor Company, Antigo, Wis., recently formed with $24,000 capital, will not establish a plant at once, but proposes to contract with foundries and machine shops for the production of small trucks and tractors for shop, factory and general work. N. C. Woodin is manager.

The Hartford Tire Pump Company, Hartford, Wis., manufacturer of automobile tire pumps, is installing additional equipment, including an oxy-acetylene welding and cutting unit.

The board of education, Wausau, Wis., is in the market for additional equipment for the manual training department of the Wausau high school.

The Central City Iron Works, Stevens Point, Wis., owned by R. A. Cook, has renewed its contract for furnishing gray iron castings to the Wisconsin division of the Minneapolis, St. Paul & Sault Ste. Marie Railway Company.

The Lakeside Bridge & Steel Company, North Milwaukee, Wis., is preparing for a large production of portable steel towers for concrete construction. The towers will be built up to 96 ft., with steel chutes for gravity feed of mixtures.

The Common Council, Manitowoc, Wis., has formally rejected all bids for furnishing a 500-hp. steam engine for the municipal electric light and waterworks plant, and is considering the purchase of a Diesel type oil engine unit. Henry Stolz is mayor.

The Felker Mfg. Company, Marshfield, Wis., will erect a 75 x 80-ft. addition to its plant and install equipment for manufacturing steel barn equipment.

The Lausen-Lawton Company, manufacturer of gasoline engines, DePere, Wis., is preparing to market a disc friction clutch designed by C. A. Lawton.

The truck shops of the Kissel Motor Car Company, Hartford, Wis., are operating with a night shift to fill rush orders for foreign shipment and a large order for taxicabs for a Los Angeles interest.

The Ashland Lighting Company, Ashland, Wis., has acquired a site for the proposed auxiliary steam plant, etc.

New Richmond, Wis., has sold an issue of $12,000 in bonds for the improvement of the municipal waterworks system. W. G. Kirchhoffer, Madison, Wis., is the engineer.

The business men's association, LaCrosse, Wis., is backing the LaCrosse Washer Company, manufacturer of washing and laundry machinery and equipment, which desires to increase its output.

At a special meeting of the board of public works, West Allis, Wis., bids were opened for $10,000 waterworks bonds for installing new pumps in the pumping station.

Cleveland

CLEVELAND, OHIO, January 4, 1915.

The year 1915 starts with the machinery market in much better condition than during the greater part of last year. As a result of foreign orders Cleveland builders of lathes and automatic machines have their stocks well cleaned out and sufficient orders on their books to keep their plants running at near full capacity for at least two or three months. Builders of machines for which export demand is small have been benefited by an increase in orders due in part to the heavy buying of war material in this country. The demand for automatic machines for export to England, France and Russia continues active, and domestic demand has improved. Lathes are also still in good demand for export. Some good business in portable drills has come from England where the trade before the war was largely supplied by German manufacturers. Dealers report business in single tool orders fairly good. The demand for second hand machinery is more active than for some time. Considerable improvement is looked for in the foundry trade this month.

The Cleveland Railway Company, Cleveland, has an inquiry out for six 16 to 13-in. lathes for its Harvard avenue shops. Other machinery equipment will probably be required.

The Forest City Engineering Company, Cleveland, will erect a seven-story factory, 118 x 125 ft., at Lakeside avenue and West Third street. It will be equipped for light manufacturing purposes and divided to suit tenants.

The Ohio Engine Company, Sandusky, Ohio, has been incorporated with a capital stock of $25,000 by M. H. Joy, manager of the Ohio Engine Sales Company, and others, to manufacture small gas engines ranging from 1½ to 6 hp. It will probably equip a plant.

The Massillon Chair & Desk Company, Massillon, Ohio, recently organized, has elected Frederick H. Snyder president; David Reed, vice-president, and Aaron Witter, secretary-treasurer and general manager. It will erect a new plant.

The Standard Fuel Oil Engine Company, Willoughby, Ohio, has been incorporated with a capital stock of $50,000. L. W. Penfield, of the American Crane Machinery Company, and others, are interested.

Cincinnati

CINCINNATI, OHIO, January 4, 1915.

The majority of manufacturers here have not yet finished taking inventories; but it is almost generally acknowledged that the past year was not a satisfactory one. The first three months of 1914 brought out a fair demand for machine tools from both domestic and foreign customers, but the summer season was a very dull one. About October 1 orders for lathes began to come in from Europe, due to the war, and a steady stream of them set in from England, Russia and France. Lately, Italy has been buying some machine tools. While the lathe orders are said to be slackening somewhat an urgent inquiry is being figured on for 80 turret lathes for finishing shrapnel cases. This inquiry comes from an American company that is said to have a large contract in hand from a foreign country.

A few orders for planers have been received recently, while vertical milling machines still continue in fair demand. Boiler and tank makers are only doing a fair business, and have comparatively few inquiries in hand, but this is to be expected at this season. Second-hand machinery is very dull.

The resumption of work in a number or railroad shops is considered an encouraging sign. Among those companies which have put on full forces in their repair shops in this vicinity are the Norfolk & Western and the Cincinnati, Hamilton & Dayton Railroads.

The Heekin Can Company, Cincinnati, confirms the purchase of a site adjoining its plant, but denies the published reports that it intends to erect an addition to its factory.

The Indiana State Normal School, Terre Haute, Ind., is inquiring for a number of machine tools to fit up a shop.

The Foos Gas Engine Company, Springfield, Ohio, has increased its capital stock from $310,000 to $360,000 to take care of contemplated extensions to its business. No building additions are planned just now.

The Robbins & Myers Company, Springfield, Ohio, has adjusted its fire losses, and has already given contract for rebuilding that part of its plant recently destroyed by fire. No appreciable delays in shipments were experienced on account of the fire, although the loss was estimated at over $100,000.

The Delco Company, Dayton, Ohio, manufacturer of automobile specialties, contemplates putting on a night force to take care of its orders in hand. No extensions to its plant are planned at the moment.

The Rybolt Heating Company, Cincinnati, Ohio, has acquired a controlling interest in the Ashland Foundry Company, Ashland, Ohio. The capital stock of the Ashland Foundry Company has been increased from $20,000 to $32,000 to take care of improvements that will be made. Tentative plans include the erection of a machine shop and assembling building, 60 x 70 ft., two stories, of brick construction. A foundry addition is also planned that will be 70 x 90 ft., one story, of brick construction. The Rybolt Heating Company manufactures a line of cast-iron hot-air furnaces, and the plans above mentioned will enable it to more than double its former output.

The Central South

LOUISVILLE, KY., January 4, 1915.

A much better feeling exists among machinery houses as the result of a general improvement in business conditions. Inquiries are more numerous, and a good proportion of these are now expected to develop into orders. Prospects in the foreign field are unusually good, and several local concerns have been booking orders for delivery abroad, notably to Cuba, South America, Great Britain and Australia. One of the chief troubles at present is delay in getting mail through to foreign destinations. Altogether, manufacturers and dealers are looking for much more active business.

The American Metallic Packing Company, Lexington, Ky., is in the market for the following equipment: Single cylinder and single drum hoisting engine; feed water heater, coil type, for 60-hp. boiler; high-pressure air compressor, 10 x 10 x 10 or 12 x 12 x 12; low pressure air compressor, 8 x 14 x 8; hoisting engine, double engine 10 x 12, three drums. The equipment to be purchased will likely be second-hand, if in good condition.

About a quarter of the plant of the Henry Vogt Machine Company, Louisville, Ky., was destroyed by fire January 1. The boiler shop, the ice can and the pipe shops were the chief sufferers. The loss is about $90,000. The offices, power plant, forging department, machine shop, foundry and pattern plant were not damaged. The company will start reconstruction at once. Henry Vogt is president, and Adam Vogt secretary. Deliveries will not be interfered with.

Following the reorganization of the Ross Chair Mfg. Company, Louisville, it was stated that the business would be greatly enlarged and new equipment installed. W. E. Ross is president.

The Folding Furniture Company, Keller Building, Louisville, has been organized and will equip a factory requiring power and wood-working machinery, about March 1.

The machine shop of Herman Knauer, Middletown, Ky., was burned recently with a loss of $2500. It has not been decided whether the equipment will be replaced.

S. J. Bell, Middleburg, Ky., will put in equipment for the generation of electricity.

T. H. Sampson, New Orleans, La., is planning the establishment of a wood-treating plant in Memphis, Tenn., for developing the color of red gum wood, to cost $5000, including boilers, retorts, etc.

The Northern Virginia Power Company, Winchester, Va., plans increasing the capacity of its hydroelectric plant at Millville, W. Va.

The planing-mill and sawmill of C. E. & E. N. Brown, Pasquo, Tenn., were burned recently with a loss of $10,000.

The Carolina, Greenville & Northern Railway Company is planning the construction of an electric railway from Kingsport to Newport, Tenn. It is incorporated with $1,500,000 capital stock. H. S. Reed, Los Angeles, Cal., is president.

Birmingham

BIRMINGHAM, ALA., January 4, 1915.

Machinery dealers feel that the worst is over and the tendency toward better conditions is much stronger. Wood-working plants have been active buyers of machine tools recently and the mine trade in the same direction is also good. Now that cotton is moving, the situation is clearing up. Inquiries are active and indicate an increasing disposition to purchase.

F. A. Munlis and P. Kuhn will establish an ice factory at Union Springs, Ala., of a daily capacity of 20 tons, to cost about $20,000.

The Southern Structural Steel Company, Bessemer, Ala., has nearly completed its new plant for the manufacture of steel cages for jails, etc.

The Parker-Beam Lumber Company, Crawfordsville, Ga., has been incorporated by I. W. Parker, G. L. Beam and associates with a capital stock of $10,000 and the privilege to increase it to $100,000 for the purpose of manufacturing lumber.

Wadley, Ga., has voted $6400 of bonds for an electric lighting plant.

The Macon Railway & Light Company, Macon, Ga., will enlarge its electric lighting system.

The Ft. Myers Lumber Company, Ft. Myers, Fla., has been incorporated by E. T. Roux, Sr., Plant City; M. S. Gonzales, Ft. Myers; E. T. Roux, Jr., and others, with a capital stock of $9000, to manufacture lumber.

E. M. Ellsworth, Chattanooga, has purchased the Vicksburg, Miss., water plant for $230,000.

Charleston, S. C., has decided to purchase the plant of the Charleston Light & Water Company for $1,500,000 and $100,000 was voted for its enlargement.

St. Louis

ST. LOUIS, MO., January 4, 1915.

An active interest in the market presages real business shortly. Some dealers are impatient, but for the most part are much encouraged over the outlook. Some tool business has been placed the past week, including a number of shoe factory orders. Second hand tools are in rather light request. The condition of the money market continues satisfactory and the dividend payments in this region will not show any material change in the aggregate from a year ago.

The Springfield & Central Illinois Traction Company, St. Louis, has completed construction plans, including a power house.

The American Folding Box Company, St. Louis, has been incorporated with a capital stock of $13,500 by T. P. Carroll, J. A. and C. A. Neumann.

The Western Mausoleum Company, St. Joseph, Mo., has been incorporated with a capital stock of $100,000 by O. C. Steinhauser, F. A. Moore and A. H. McDonald.

The Waverly Brick & Coal Company, Kansas City, Mo., has increased its capital stock from $300,000 to $600,000 for the purpose of adding equipment, etc.

The Smith Fence Post Company, Leslie, Ark., has been incorporated with a capital stock of $30,000 by D. H. Smith, William Henson and William Ashley for the manufacture of steel fence posts.

The Co-operative Cold Storage Company, Leslie, Ark., will receive bids for furnishing ice-making machinery.

A hydroelectric plant of 2500 hp. is to be constructed on the Caddo River, near Glenwood, Ark., by O. E. Grimes, Tulsa, Okla., and others, at a cost of about $250,000.

The Arkansas Water Company, Little Rock, Ark., will increase its present capacity, expending about $20,000.

A factory for the manufacture of pumps of the sucker type will be equipped at Blytheville, Ark., by A. D. Cook, Lawrenceburg, Ind.

The Pryor Mill & Feed Company, Pryor, Okla., is reported in the market for electric generating equipment and a gas engine power plant.

The St. Louis & San Francisco Railroad, of which N. M. Rice, St. Louis, is purchasing agent, will install additional machinery in its shops at Afton, Okla.

Wilburton, Okla., has voted to equip a waterworks, sewage disposal plant, etc., to cost about $80,000. The Benham Engineering Company, Oklahoma City, Okla., is in charge.

The roundhouse and shops of the Chicago Rock Island & Pacific Railway, at Mangum, Okla., which has been burned, will be reconstructed. C. A. Morse, Chicago, is chief engineer.

The commission of the new river drainage district, Gonzales, La., of which Leon Pickard is president, will receive bids until February 4 for equipment to excavate about 2,000,000 cu. yds. of material.

A franchise for supplying electricity, power and illuminating has been awarded to Robley S. Stearns by the City Council, Gretna, La. A plant will be equipped at once.

An issue of $40,000 of bonds by the Waterloo drainage district commissioners, Pine Bluff, Ark., will be devoted to the addition of pumping equipment, etc.

Texas

AUSTIN, TEXAS, January 2, 1915.

Not much of moment is to be noted in the machinery and tool trade this week. Machinery contracts of considerable magnitude are pending and will probably be closed the early part of the year. General business conditions show some improvement.

The Stone & Webster Engineering Corporation, Boston, Mass., will call for bids for the construction of an extensive system of terminals for its interurban electric railways at Dallas in about 60 days. The franchise for the proposed terminals is now pending before the city commission. Edward T. Moore is general manager.

It is announced that the Magnolia Petroleum Company, Beaumont, has adopted plans for the erection of an oil refinery at Beaumont to cost about $15,000,000. The proposed improvements also involve the construction of docks, warehouses and ship-side terminals on the river. Its plants are all connected with the oil fields of Texas and Oklahoma by pipe line system. E. R. Plunily is manager at Beaumont.

John Schock, Wichita, Kan., is at the head of a syndicate that has just been formed with a capital of $750,000 to bore wells upon a tract of 25,060 acres of land near Chandler, Ariz. Pumps will be installed upon each well and the water used for irrigation. The other members of the syndicate are Eugene Kelly, Los Angeles, Cal.; J. R. Rittenhouse and Eugene Detweiler, Phoenix, Ariz.; O. S. Stapley and Paul B. Beville, Mesa, Ariz., and W. H. Renck, Higley, Ariz.

It is announced that the Socorro Mining & Milling Company, Mogollon, N. M., will expend about $90,000 in completing its electric power plant.

The Pacific Northwest

SEATTLE, WASH., December 29, 1914.

The tool market shows only slight increase, but dealers are optimistic. A noticeable activity is anticipated in the lumber business in the Northwest. Mills closed down for several months will reopen shortly with full crews.

An order for 30,000 fir railroad ties was recently placed with the Puget Mill Company, Seattle, for an English railroad system. This order marks the beginning of export business which is expected to run into millions of dollars.

The Brown-Lewis Corporation, Walla Walla, Wash., has been incorporated by A. B. Fox, E. Brown and F. G. Lewis, with a capital stock of $100,000. It will build a factory and manufacture harvesting machinery, tractor engines, etc. It is reported in the market for machinery.

The Carstens Packing Company, Tacoma, will build a glue factory, fertilizer plant, hide plant, hanging rook, machine and carpenter shop, etc., in Spokane. G. C. Huber is manager.

The port of Portland, Ore., will receive bids for furnishing and installing machinery in the steel dredge Columbia.

The Mackie Mill & Mercantile Company, Gettysburg, Wash., is reported in the market for machinery for a shingle mill of 200,000 shingles per day capacity.

The Staub Paper Company, Libby, Mont., has plans for remodeling a brewery in Coeur d'Alene, Idaho, into a paper plant.

The Take-Down Mfg. Company, 700 Westlake avenue North, Seattle, of which W. B. Parmelle is manager, received the award for constructing 1200 portable bungalows, to be shipped to Belgium. The contract approximates $500,000.

Wallis Huidekoper and Charles O'Donnell, Billings, Mont., have purchased a site near Billings for a packing plant and stockyards. Plans are under preparation and bids for construction and machinery will be received in the spring.

C. A. Broad, Spokane, and H. L. Wilson, Walla Walla, each submitted a bid of $48,000 for construction of the Attalia drainage system, Attalia, Wash. The installation includes five pumping plants, each equipped with electric motor, two to have 250 cu. ft. per min. and three of 140 cu. ft. per min. capacity.

The Empire Mfg. Company, Spokane, Wash., and the Pendleton Iron Works are asking for subscriptions for stock of a consolidated company formed to manufacture a rotary pump, an iceless refrigerator, split wood pulleys and other articles.

M. H. Houser, Portland, Ore., is planning a large addition to his grain elevator plant at Seattle.

The Pacific Iron Works, Portland, has completed the frame of its new structural shop, 62 x 520 ft., and is working on the machine shop and foundry building. A large electric crane will be installed in the structural shop.

The Idaho Power & Concentrating Company, Sandpoint, Idaho, is considering plans for the addition of a 600-hp. hydroelectric unit to its plant.

The Utah Glass Company has started construction of a plant near Moroni, Utah, for the manufacture of bottles and window glass. The main furnace will have a capacity of 12 tons daily.

Eastern Canada

TORONTO, ONT., January 2, 1915.

Robert Hobson, general manager of the National Steel Car Company, Hamilton, Ont., has returned with large orders from abroad, and Mr. Magor has returned from France with a war material order amounting to $1,000,000 and with an order from England for material amounting to $500,000. Mr. Hobson has large orders for steel goods from British manufacturers. The bulk of the orders will be filled by the Montreal plant. A large part of the raw material will be supplied by the Hamilton plant.

The Steel Company of Canada, Hamilton, Ont., has secured an order for $1,000,000 worth of special steel for French and British manufacturers, and it is reported that this will mean the complete re-opening of the company's plant at full capacity day and night for several months.

Damage to the extent of $100,000 was done to the plant of the New Brunswick Pulp Mill, Lower Derby, near Newcastle, N. B. The company will rebuild.

The Dominion Iron & Steel Company, Sydney, N. S., will construct a mill for the manufacture of small material. The building will be completed and the machinery ready for operation by March 1, 1915. A dozen wire making machines are being installed to handle heavy orders from England.

The Ontario Specialties, Ltd., Ottawa, Ont., has been incorporated with a capital stock of $100,000 by P. T. Murphy, Midland, Ont.; G. F. Perley, R. W. Dawson, and others, to operate a foundry, etc.

The Beck Mfg. Company, Ltd., London, Ont., has been incorporated with a capital stock of $400,000 by Adam Beck, William Kingston, R. M. Toothe, and others, to manufacture lumber, boxes, etc.

The Radiant Sign Company, Ltd., Toronto, has been incorporated with a capital stock of $50,000 by F. C. Hunt, 421 Marion avenue; R. S. C. Stalker, H. J. Brown, and others, to manufacture electric signs, etc.

The D. Derbyshire Company, Ltd., Brockville, Ont., has been incorporated with a capital stock of $75,000 by Daniel Derbyshire, G. E. Smart, J. J. Venney, and others, to manufacture dairy supplies, etc.

The Eplett Mfg. Company, Ltd., Cumberland, Ont., has been incorporated with a capital stock of $100,000 by R. K. Eplett, William Graham, Samuel Karr, and others, to manufacture paints, oils, etc.

The Target Practice Rod Company, Ltd., Ottawa, Ont., has been incorporated with a capital stock of $100,000 by R. E. Reardon, W. G. Charleson, W. R. Greene, and others, to manufacture target attachments for fire arms, military equipment, etc.

Blair & Rolland, Ltd., Montreal, has been incorporated with a capital stock of $50,000 by H. C. Blair, C. G. Ogden, Humbert Mariotte, and others, to manufacture lumber, etc.

The Chambly Manufacturers, Ltd., Montreal, has been incorporated with a capital stock of $200,000 by A. P. Mathieu, P. A. Beaudry, Armand Mathieu, and others, to manufacture machines, machinery supplies, etc.

The Preston Oil & Gas Company, Ltd., Preston, Ont., has been incorporated with a capital stock of $250,000 by Alexander Neubaur, W. E. Wildfong, W. H. Dumart, and others, to refine oils.

The Canadian Aluminum Goods Supply Company, Ltd., Toronto, has been incorporated with a capital stock of $100,000 by G. H. Sedgwick, 58 Wellington street, East, Duncan McArthur, J. A. Donovan, and others.